MDDC - 1101

UNITED STATES ATOMIC ENERGY COMMISSION

REMOTE CONTROL ANALYTICAL APPARATUS

by

R. E. Curtis

Hanford Engineering Works

Date Declassified: June 12, 1947

Issuance of this document does not constitute authority for declassification of classified copies of the same or similar content and title and by the same author.

Technical Information Branch, Oak Ridge, Tennessee
AEC, Oak Ridge, Tenn., 4-25-49--850-A389

Printed in U.S.A.
PRICE 20 CENTS

REMOTE CONTROL ANALYTICAL APPARATUS*

By R. E. Curtis

Alpha, beta, and gamma radiation may be guarded against in four ways:

1) By restricting the size of the sample used.
2) By keeping the body at a safe distance from active sources.
3) By use of shielding.
4) By good housekeeping, personal cleaniness, and continuous monitoring of work areas.

In order to control the size of the samples used, micro and ultra-microchemical analytical procedures are used. The use of microchemical procedures have definite advantages in radiochemical work over the macrochemical. In addition to decreasing the danger of high toxicity and radioactivity, they are fast, inexpensive, and require a minimum of space, and produce only a small degree of destruction of valuable material. In addition microchemistry requires little or no theory which is not altogether an essential part of ordinary scale chemistry.

The proper performance of microchemical analyses requires:

1) A thorough knowledge of general chemical principles, and
2) The application of correct and careful techniques.

The approximate magnitude of sample sizes range in size from a thousandth of a milliliter to a tenth of a milliliter. Certain of these small amounts of materials contain enough radioactive materials that, to handle them safely within tolerance limits, remote control equipment provided with a beta shield and to allow handling from a distance of one foot from the sample is necessary. In routine control operations the only practical protection against gamma radiation is distance. The samples containing dangerous amounts of plutonium, e.g., over ten to the minus fourth milligrams, are considered safe to handle for analyses only when completely enclosed.

The apparatus and special devices shown in the following pictures are designed to handle small samples in accordance with the limitations listed above. Picture No. I is the so-called remote control operated panel board. It allows for safe handling of hazardous solutions, ease of operation, permits methods standardization, enables the operator to achieve high precision, enables safe operation, is easy to decontaminate, and is an attractive unit. The unit consists of a base and face panel of one-fourth inch 2 S aluminum. The face panel is 18-3/4 inches high and 24 inches wide. The unit is 12 inches deep. All aluminum parts of the unit are finished with the baked, synthetic enamel and then covered with a white lacquer. This type of finish allows for easy decontamination in that radioactive materials which may be spattered on the white lacquer can readily be removed by wiping the surface with a pad of cheesecloth soaked with a suitable lacquer solvent which removes the lacquer from the baked on enamel, and then this surface can be recoated with the air dry lacquer, giving a new surface which is entirely free of any radioactive material. Should the radioactive materials which are usually in concentrated acid solutions go through the white lacquer surface to the enamel, then the material may be removed by an acid wash of the enamel surface. After the acid wash the enamel may be covered with the white lacquer.

---

*Presented at the June 1947 symposium on radiation·chemistry and photo-chemistry at the University of Notre Dame.

On the front of the panel are mounted the following:

1) Micro buret.
2) Reaction vessel.
3) Ring heater mounted on a ball joint for easy positioning.
4) Switches for heater and the millivolt heater.
5) 3-way telephone type switch for adjusting the millivolt meter.
6) Two control knobs for use in adjusting the millivolt meter.
7) Pulser motor for agitation of solutions in the reaction vessel.
8) Meter with 4 inch dial which reads 0 to 1500 millivolts in graduations of 20 millivolts.
9) Two variacs, one for controlling the ring heater, the second for controlling the pulser motor.
10) Burner with housing for flaming the platinum electrode.
11) Three 2-way stopcocks, one for controlling the nitrogen flow, the second for control of the gas flow to the burner, and the third for control of the pipette cleaner.
12) Two 3-way stopcocks, one for pulser control and emptying the reaction vessel, the second for fume removal and emptying of the reaction vessel.
13) Two fixed position hosecock clamps for adjusting the amount of pulsing.
14) Two jewel lights which light up when the heater is on and when the millivolt meter is on.
15) Two terminals for connecting in the electrode limits to the millivolt meter.
16) Fluorescent light for direct illumination of the panel.
17) Pipette cleaner.
18) Two bubble traps for controlling the nitrogen flow. The first tube is filled with water and indicates the rate of flow. The second tube is empty and is used as a trap for any spray which may come from the first tube.

Figure 2 shows the rear of the panel on which are mounted an enclosed box for housing the electrical circuit including the Epply standard cell, a pulser motor, and the tygon tubing, electrical cables, and so forth. The millivolt meter amplifier proper is a separate unit from the panel and is connected to the unit by three electrical cables. The problems of inclusion of the sample to allow for safety requirements are completely satisfied by the glass reaction vessel. Stirring of the solution in this vessel is accomplished by air displacement which is more satisfactory from a safety standpoint than any other type of stirring procedure. In addition to the stirring facilities, vacuum can be applied to the stirring arm, and with the aid of the stopcocks the solution can be withdrawn into a waste container. Consequently, the complete analyses is done in an enclosed vessel. Stirring reaction and sample removal are accomplished without the operator either handling or coming in contact with the solution. The electrodes are platinum. One electrode is inserted into the bore of the micro burette and the second is inserted into the sample.

The second picture is a sampler which was designed to enable the taking of a secondary sample from a comparatively large primary sample. The advantages of the sampler are: (1) permits rapid and safe sampling of extremely hazardous samples. (2) maintains positive control over all safety factors, and (3) adaptable to numerous techniques and procedures.

This sampler is conveniently divided into four parts (1) the base and shields, (2) the holders and carriers, etc., (3) the stirrer, and (4) the manipulator and pipette control. The base of this sampler is stainless steel, about 3/16 inch thick. This base may either be suspended by brackets from the wall or supported on legs as shown in the picture. There are two shields attached to the base; one shield is of glass, preferably lead glass, which gives protection to the operator while permitting clear vision of the sampling operation. The second shield is of stainless steel and it is perpendicular to the glass shield. It provides adequate protection to the hand and arm of the operator. There are four holders on the sampler; they are, (1) holder for tongs for pipette removal from the manipulator, (2) a holder for vessels containing rinse liquid, (3) a positioner and holder for the secondary sample carrier and (4) a positioning ring for the primary sampler carrier. The stirrer is a short piece of platinum wire attached to a mechanism for rotating it slowly. This mechanism is a flexible shaft run off a small electric motor having a variable speed drive. The manipulator is two directional, operating around a

vertical post. Its position on the post is controlled by a spring trigger arrangement since a pressure of the fingers of the hand grasping the manipulator will release it. The end of the manipulator over the primary sample carrier is equipped to carry a pipette. The control on the manipulator is all metal.

The entire sampler is coated with white lacquer to enable clean-up should any contamination occur. Figures 2, and 3 show other views of this sampler.

Picture No. 3 is a laboratory apparatus for extracting through the use of a solvent. This apparatus permits safe handling of hazardous materials, provides ease of operation, is fast to operate and easy to decontaminate. The hydraulic actuated titrating table is an interesting feature of the unit. Figures Nos. 2 and 3 show additional detail of the device. The entire unit is made of 1/4 inch 2 S aluminum. The face panel is 13 inches high, 14 inches wide and 6 inches deep. The base is 14 inches wide, 12 inches deep and 2 1/4 inches high. All of the aluminum parts are finished with a synthetic enamel and then covered with white lacquer. The tubing is Tygon and the remote control knobs are of stainless steel. The glass extractor is made from 1/2 mm bore pyrex capillary and contains a cross center glass filter in the bulb. On the front of panel are mounted (1) the pyrex extractor, (2) the hydraulically actuated titrating table, (3) a base, which holds the solvent receiving flask, (4) Lucite safety shield to cover the receiving flask. On the base of the panel are mounted (1) a control for raising and lowering the titrating table, (2) a lock for titrating table control, (3) a syringe for manual control of the extractor, (4) three-way stop cock for vacuum control of the extractor.

Picture No. 4, Figures 1, 2 and 3 show a remote control panel unit for spectrophotometric determination. This panel unit is also made of 2 S aluminum, covered with the synthetic enamel and then with white lacquer. The base measures 13 x 23 inches and is 1/2 inch thick. The front panel measures 17 x 23 inches and it is 1/4 inch thick. A stainless steel plate 16 x 4 inches is mounted on the base in front of the front panel, and it is grooved on both long edges, and it may be raised and lowered by an arm turning a Helical slot in a sleeve fastened to the base. Upon the front panel are mounted four 10 ml dispensing burettes, placed so that the tips are located near the outer edge of the steel plate. In the back of the panel board are four 1,000 ml reservoir bottles, one for each of the burettes. These reservoirs may be filled with the proper reagent by means of a vacuum, the source of the reagent being connected to the reservoir by glass tubing and ground joints on the front of the panel. The ground joints may be broken so the source of reagents may be removed. The filling of the reservoirs, and also the burettes, is controlled by glass stop cocks mounted on the front of the panel. On the side of the panel is mounted an agitator, which consists of an arm rotated slowly by an electric motor. Fastened to the ends of the arm are two absorption and cell holders. These holders are at a slant to the horizontal, the slant of each being opposite to the other. A switch to control the agitator motor is mounted above the agitator on the panel. Another switch is mounted directly above the agitator switch to control behind the panel illumination. The operation involves the following: transfer of the proper size sample to each of the absorption cells, and setting of the cells and carrier on the steel plate so that the guide screws in the carrier fit into the grooves and the steel plate, and so that the neck of the cells is toward the front. The carrier and cells are slid under the burettes so that the tip of the burette is over the neck of the cell. The steel plate is then raised by pushing the elevated arm from left to right. This will bring the tip of the burette into the neck of the cell. The proper amount of the reagent is then discharged from the burette into the cell. The steel plate is then lowered by pushing the elevated arm from right to left. The carrier is then slid along the steel plate until the next cell is lined up to the burette tip. The operation is then repeated. This is performed for each addition of reagents to each cell. When all reagents have been added, the cells are stoppered with a cork and the absorption cells are placed in the holders on the agitator. A rubber band is slipped around the neck of the cell to hold it in the agitator. The motor switch is thrown to start the agitator. After proper agitation, the agitator is stopped and the cells removed. They are then placed in a spectrophotometer and read against a previously prepared blank.

Picture No. 5 shows various types of vessel holders, holding various sizes and types of glass vessels containing radioactive solutions. These holders provide adequate shielding, minimize handling by tongs, are easily decontaminated, and hazardous materials contained in the vessel is maintained at a safe distance and the dimensions of most of the holders are standardized.

In general, the remote control vessel holders are fabricated from stainless steel or chromium plated brass. The vessel support is constructed for a specific type of vessel and is attached to a square metal base. The shielding in most instances is 1/2 inch thick Lucite which is attached along one side of the base with machine screws. The width and height of the shielding depends upon the size of the vessel to be used. A handle with an overall length of about 18 inches is attached to the center of the metal base along the same edge as that of the transparent shielding. This handle is usually fabricated from 1/4 inch rod and equipped with a plastic handle for grasping the unit firmly. An inverted "V" metal support is attached to the metal handle, directly in front of the plastic handle. This support prevents tipping of the holder.

The operation and use of shielded holders is simple and obvious. The last vessel, which is to be carried or transported, is inserted into a suitable holder. Insertion of vessels into the holder may be done by hand if the vessel is known to be clean and does not contain any radioactive materials. Otherwise, the vessel must be inserted by tongs.

The individual holders are as follows: (1) Test tube holder, 1 mm, (2) Volumetric flask holder, 1 mm, (3) Micro titration disc, (4) Beckman cell, (5) 10 mm beaker, (6) 25 mm beaker, (7) 25 mm Erlenmeyer flask, (8) Digestion flask, (9) Micro Kjeldahl distillation flask, (10) 125 mm Superatory funnel, (11) 125 mm Gooseneck Superatory funnel.

Picture No. 6 shows the titration dish tongs which are used to manipulate micro titration dishes. The mechanical action of these tongs gives positive grip on titration dishes. The tongs are activated by a simple and easily used trigger, and they are simple to construct and maintain. Essentially, the tongs consist of a head about 2 1/4 inches long, 1 inch wide and 3/16 inch thick. The jaws of the tongs are segments of a circle 1/32 inch in diameter, so grooved as to grasp a micro titration dish firmly. The jaws are activated by a set of levers which in turn are activated by a rod running the length of the handle inside of the handle. The trigger-at-the-grip end of the handle permits closing of the jaws by simple finger motion. The jaws are opened by a spring. The standard tongs measure about 15 inches in overall length but may be lengthened or shortened to fit the occasion. A so-called short form has been built with an overall length of 9 inches. The operation of the tongs is simple. With jaws open, the tong head is lowered over the dish to be picked up. When in place, the trigger is slowly pulled, closing the jaws and allowing the dish to fit into them. A firm pressure is maintained on the trigger while the dish is in the tongs. The dish may be released by merely releasing the finger pressure. Decontamination is simplified by coating the jaws of the tongs with white lacquer.

Picture No. 7 shows the wiping tong, which is used to hold small pads of absorbent paper used in wiping the pipette and burette tips known to have radioactive materials on their surface. The tongs are activated by a simple and easily used trigger which is simple to construct and maintain. The design permits shortening or lengthening of the handle to permit varied application. Mechanical action gives a good grip on wiping pad. Essentially, the tongs consist of a head about 1 inch long, 1 1/2 inches wide and 1/2 inch deep when the tongs are open. The jaws of the tongs are similar to leaves of a book. They are together, 1 x 1/2 x 3/4 inch in area and so constructed that they close in the middle. The outside edges of the jaws have two small hooks which rise above their plane and act to hold the pad in place as the jaws are shutting. The jaws are activated by simple lever mechanism connected to a rod running the length of the handle, inside of the handle. This rod is controlled by a trigger type handle and a spring. The standard tongs measure about 15 inches in overall length.

The operation of the tongs is simple. With the jaws open, the tong head is inserted into a box or carrier containing the wipe pads. These pads are pieces of absorbent paper 1 1/2 x 3/4 inches and about 1/8 inch thick. They are packed in a box so that the rough absorbent side is facing in the back of the box or carrier. The tong is inserted as far as it will go, the trigger is pulled and the top pad will be picked up in the tongs. The tongs are then removed from the dispenser, used in the desired fashion and then held over an open waste disposal container. Complete release of the pressure on the trigger will permit the jaws to open wide and the wipe will fall into the container. It is necessary that care should be exercised to keep the jaws partly closed while the wipe is in place, otherwise the wipe will drop away from the jaws.

Picture No. 8 shows four types of remote control handling tongs which are generally used in laboratory operations, where distance between the operator and the object being handled is essential. The mechanical action of these tongs is designed to give a positive grip and they are simple to construct and maintain. The tong is activated by simple lever action and spring. The design permits easy modification of the jaws to give maximum versatility. The design permits ready fabrication from stainless steel tubing giving light, corrosion resistant tongs.

The lever arms which are the handle of the tong, are approximately 16 inches long. The head of the tongs, which is varied to suit the desired purpose, generally occupies about 2 inches of the tong length, making the overall length about 18 inches. As shown in the picture, four head types have been used. They are as follows:

Type A is designed to pick up horizontal objects, such as pipettes which are lying in a horizontal position. The jaws have some freedom around their point of attachment, thus permitting them to adapt themselves automatically to hold objects tightly.

Type B is a general purpose tong, the head being an extension of the final lever arms of the handle.

Type C is designed to pick up titration dishes, small watch glasses and etc. The jaws are similarly shaped to the jaws of the titration dish tongs described previously.

Type D, the companion of Type A, is designed for picking up round or conical objects from the vertical position. It is of value in such operations as changing spectrophotometer cubettes. The operation of the tongs is simple and obvious. Better service can be obtained from some tongs by covering their tips with rubber tubing.

Picture No. 9 shows various types of disc carriers which are used to carry assay discs from the laboratory to the counting rooms; also, they are used for the temporary storage of assay discs. They are inexpensive to manufacture, easy to clean, and compact. The type shown in the picture have the disadvantage of offering little shielding against certain types of radiation hazards.

The transparent carriers are designed for carrying 16 - 1/2 inch discs and 9 - 7/8 inch discs respectively. They are constructed by milling depressions of the right size in squares of Lucite or Polystyrene. The holes are generally 1/16 inch deep. Offset holes, somewhat smaller, with their centers on the circumference of the larger holes are drilled somewhat deeper and thus permit tongs to be inserted under the disc for removal after disc insertion or insertion before disc removal. A plain cover is provided by a sheet of 1/16 inch plastic. Two pegs in opposite corners of the base are matched by two holes in the opposite corners of the cover and thus provide a means for holding the covers in place.

The metal carriers shown in the picture are used for transporting discs which are too hazardous from the standpoint of radioactivity for handling in the plastic carriers. The metal carrier on the extreme right in the picture consists of 20 brass leaves milled to a depth of 1/16 inch in the center provided for the desired disc size. A smaller hole is milled in offset to permit tweezer insertion. The leaves are designed such that they can be opened only when the small lever under the handle is pulled out. When this lever is closed, all leaves are in the closed position and are locked. Thus only one disc at a time need be exposed and considerable protection is given to the operator. The carrier should be loaded from the bottom up, and the leaves are so numbered, in order to provide maximum shielding to a person carrying the disc.

The metal carrier shown in the upper left corner of the photograph is used for transporting standard discs and it provides ready access to the disc but has the disadvantage that more than one disc is exposed at a time. The carrier consists of two blocks of brass fastened to a common handle. The blocks have been milled to permit the insertion of 20 discs each. The milling is in the shape of a "U" and is designed to handle 22 mm discs. The milled slots are cut so that vertical movement of the disc is impossible. The door of the carrier, common to both blocks, has on its back a pair of spring slips, each cut to provide an individual spring to hold each disc in its slot as far as possible.

Picture No. 9 also shows another type of this carrier, which holds a small number of discs and is useful for transporting discs within a Counting Room. As shown, this carrier has a transparent plastic top which provides visibility. The base is made of brass and it has four places for discs milled into it,

together with the necessary depressions for tong insertion. The brass handle is attached directly to the base, while plastic knob is attached to the plastic cover. The light spring between the two holds the cover in any desired place, but permits the position to be changed readily. A "U" shaped opening put in the cover permits ready access to the disc. A corresponding opening, cut in the base at the blank, or closed position, prevents dust from accumulating on the base during periods of storage and then being carried under the cover on to the disc. The use of the carrier is simple and obvious. The carrier should be kept in a closed position when not in use.

Picture No. 10 shows a covered rotary disc carrier which is used to transport and hold the discs which are too hazardous for normal means of carrying and handling. This carrier and the tongs, which go with it, provides adequate protection to the operator since in loading and unloading the operator is completely shielded. An additional advantage is that the discs are locked in place and can be removed only with the special shielded tongs. The carrier consists of a brass cup 5 1/4 inches in diameter, 1 1/8 inches high, with the walls and the bottom 1/8 inch thick, inside of which is placed a brass disc 5 inches in diameter and 1/2 inch thick. The top surface of this disc has six flat bottom radial slots, 1/8 inch deep, 15/16 inch wide and 1 15/32 inch long. Through each of these slots are two slots parallel to the radius of the disc that allow the special tongs to pass under the disc. A disc of Lucite 5 inches in diameter and 1/2 inch thick also fits into the cup. A handle and the locking device project through the Lucite cover. The handle serves for carrying the holder and for positioning the slotted disc with respect to the loading port in the side of the cup. A ball bearing snap lock holds the disc in the proper position for loading and unloading. The disc can also be locked with a pin lock so that the loading port is completely closed at one position.

The special tongs are actually fork like in operation. They consist of a stainless steel fork, especially designed to hold a disc mounted on a formed 1/8 inch stainless steel rod. A Lucite shield, 6 inches in diameter and 3/8 inch thick, is mounted 4 1/2 inches in back of the fork. The bottom edge of the shield has a flattened portion 1 1/2 inches long to keep the tongs from rolling when not in use. A plastic handle 4 inches long is mounted behind the shield.

Picture No. 11 shows a hooded sample evaporator which is used for evaporating radioactive solutions on 22 mm platinum disc and watch glasses. The desirable features of this apparatus are (1) evaporation is rapid because the infra-red rays from the lamp travel directly to the solution and penetrate it, (2) bumping and spattering is minimized, (3) it is easily manipulated, (4) sturdily constructed, and (5) easily decontaminated.

The evaporator is fabricated from stainless steel. The upper section is simply a cylinder which houses a single 250 watt infra-red lamp. The lamp socket has a shield which fits down over the opening in the top, thus closing it off. The upper part swivels on an upright post from the base. It can be adjusted to the desired height by a screw clamp located on the post. The base is a solid piece of stainless steel with a steel sample card holder welded to it.

Picture No. 12 shows a different type of hooded evaporator for handling highly hazardous solutions. The construction assures efficient removal by means of a hood arrangement connected to a vacuum source. It is fabricated from stainless steel. The upper section houses a single 250 watt infra-red bulb. The lamp socket is equipped with a disc such that the lamp slides in through the top end of the cylinder. The lower end is partially closed by a ring to fit snugly around the hooded disc carrier. This arrangement permits only the carrier to be heated. When the carrier and its platform are in the top position, the vacuum system insures proper vapor flow. A short side arm on the shield provides the vacuum line attachment. The lower section forms a swivel base on which to place the hooded disc carrier on which the samples are prepared. A guide in the center of the carrier, directly beneath the shield is attached to the shield. The base is attached to a toggle link system to allow the base to be raised and lowered easily and smoothly. The complete assembly is attached to the underside of the bench shelf by means of a support bracket.

To operate this evaporator, a hooded disc carrier is placed on the platform of the evaporator. The clean platinum discs are placed on the carrier. The discs are then prepared as usual for analysis. After the discs have been prepared, the top of the hooded flask carrier is removed and the base platform is moved to a position directly below the shield. The lever at the top of the shield is moved upward slowly until the platform support beam engages the guide lug on the shield. Then the lever is moved upward as

far as possible. The vacuum and infra-red lamp are turned on, and the sample is evaporated to dryness. Four discs may be prepared at one time using this evaporator. The top of the hooded disc provides ample shielding to the operator and exposes only the disc that is being prepared. The evaporator works equally well on alpha, beta and gamma determinations and operating procedures are identical.

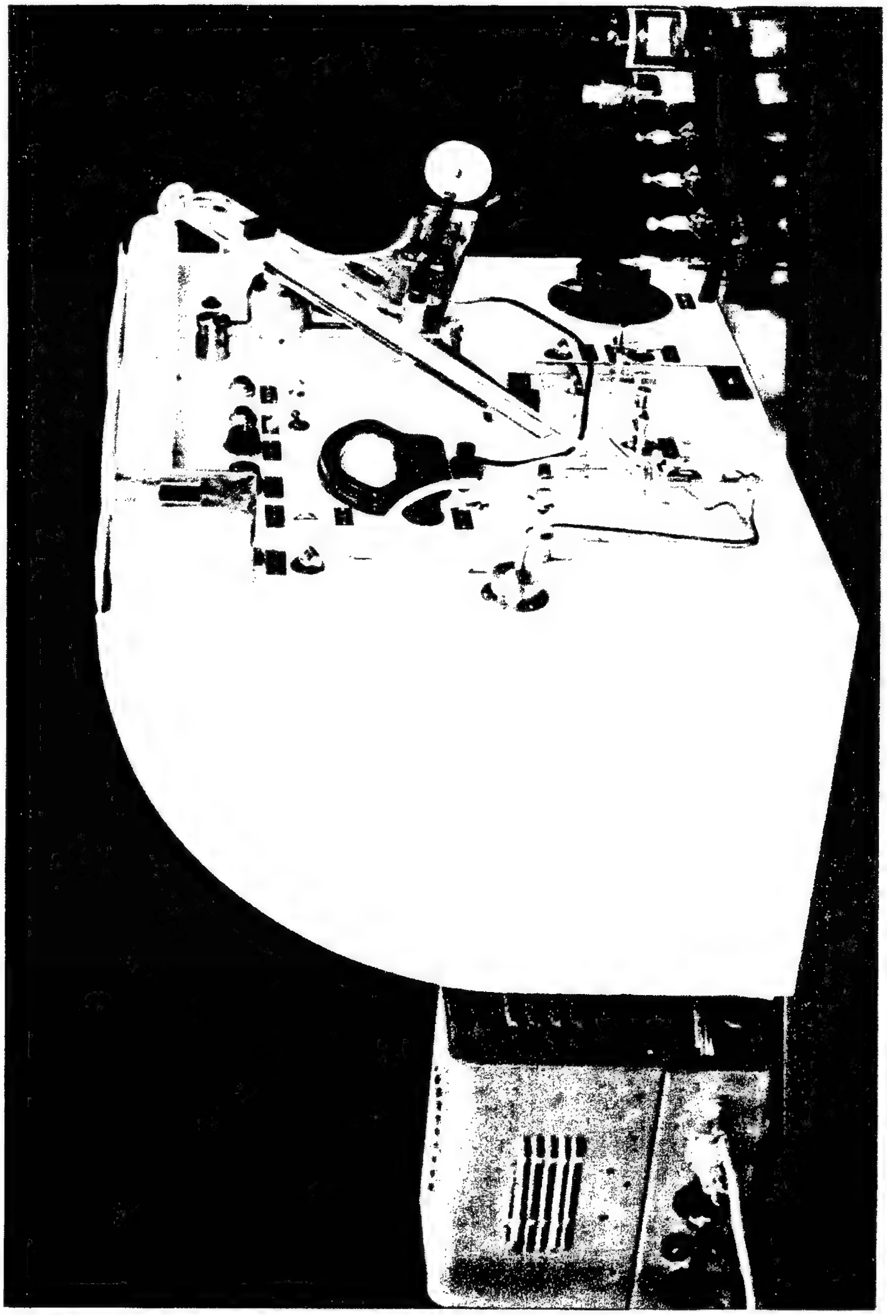
Picture No. 13 is a manipulator to permit the safe manipulation of radioactive solutions. Several types of manipulators are in use as indicated in the picture. These types are as follows: (1) Pump handle manipulator (Figure No. 1). This manipulator was designed for the sampling of liquids or pipetting of liquids. A motion in two directions can be secured directly and some motion in a third vertical can be obtained by loosening the screw on the base post. The biggest disadvantage of this type of manipulator is the fact that both motions are in a form of an arc. This is particularly objectionable in the vertical direction. A second type of manipulator is the simple two dimensional manipulator as shown previously in the primary sampler picture. It is similar to the pump handle manipulator described above, however, it has the advantage that its vertical motion, obtained by raising and lowering over a post, is truly vertical and not an arc. A third type is the three dimensional screw manipulator. This is the most versatile of all manipulators. It is generally similar to the microscope stage except that the third vertical screw is attached. The manipulator can be built in a desired size of throw or screw pitch. The fourth type is called a special Misco manipulator (Figure No. 2). It is designed for work where a stage is necessary along with the manipulator. The stage, which is a modified titration table, has two dimensions controlled by screws, vertical and forward. A third could be added if desired. The manipulator itself is a three dimensional screw. It is on a ball joint so arranged that the stage can be tilted in any desired direction up to vertical. It is used most often in calibrating pipettes with mercury. The fifth type of manipulator (Figure No. 3) is the triple platen manipulator. This device uses three plates, grooved and covering steel balls to provide the necessary motion. The whole unit is set upon a ball and socket and can be tilted in any direction desired up to the vertical. In actual use motion is imparted to the handle and is reproduced in the stage at the center. Any desired device can be connected with this stage. Within the limits of the device, almost any motion can be imparted.

Picture No. 14 shows a dry waste disposal shield used for the disposal of hazardous waste solutions which are dry enough that they will not soak through a paraffin-impregnated cardboard. This simple disposal shield provides adequate protection under normal circumstances and provides a quick and easy disposal of dry waste materials. It consists merely of the shield made of stainless steel tubing about 4 inches deep and 8 inches high which has been welded to a stainless steel disc made of approximately 1/4 inch stainless sheet. Inside the shield fits a 1 pint carton made of paraffin-impregnated cardboard of the kind commonly used to dispense such materials as ice cream. In use the shield should be set in a convenient place, and a clean, empty carton placed in it. Dry waste may be disposed into it as desired. When the carton is full or when the radiation becomes too great in spite of the shielding, the cover should be placed on the carton and it should be discarded in a prescribed manner.

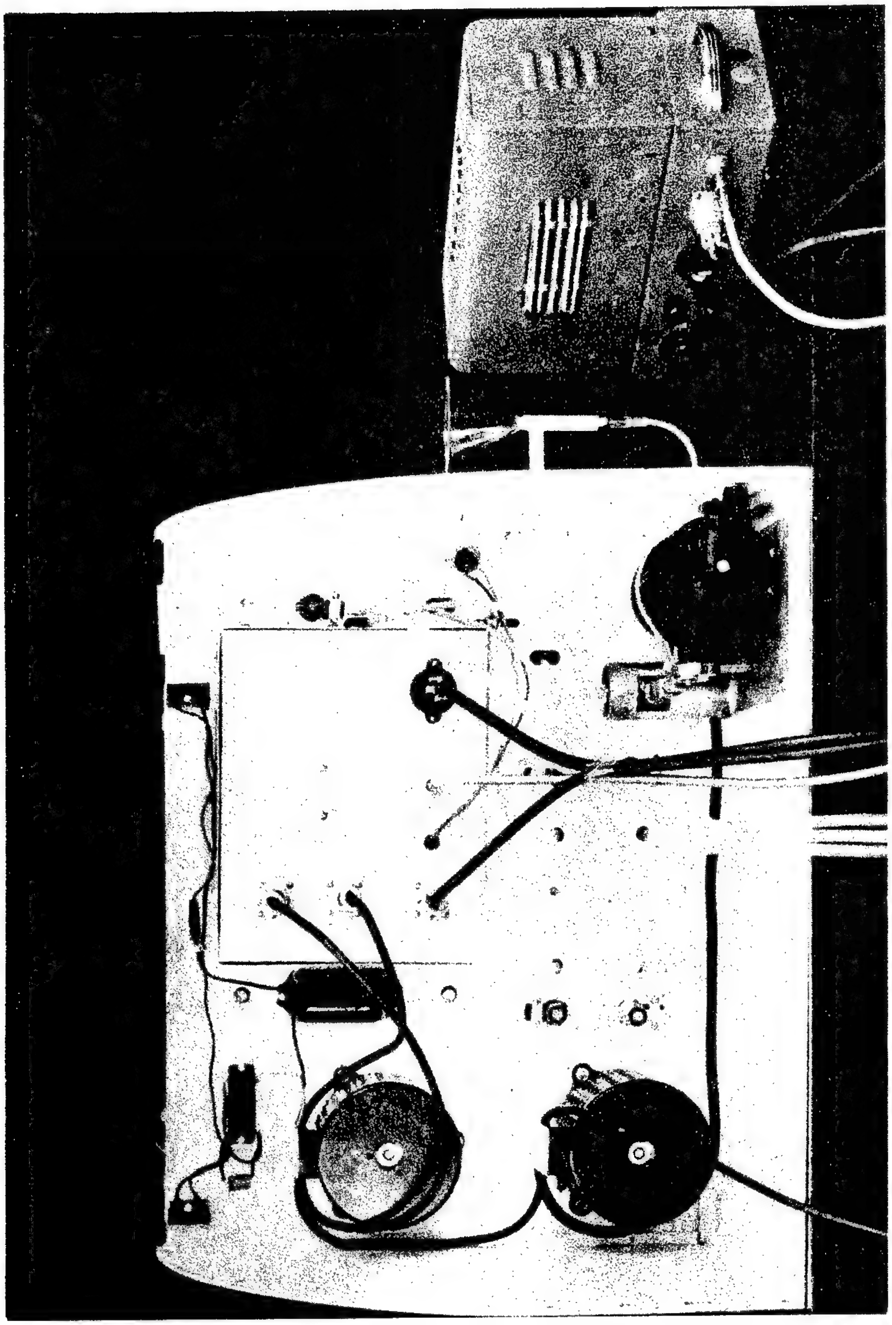
Picture No. 15 shows a titration shield which is used in drop scale titrations to permit direct view of the vessel and the solution being titrated, yet providing adequate shielding from radioactive materials in the samples. The shield consists of a metal frame attached to a piece of sheet metal. This in turn holds a small metal casting; the frame holds pieces of lead glass. The piece of sheet metal serves as support for the frame and casting, and the latter provides a hole through which the entire apparatus can be suspended from a ring stand post. Glass protection is provided only on two sides, and the entire device can be swung out of place to the left when desired. The right side is left open to permit the use of a capillary burette, while the top and back are left open to permit ready access of any extra equipment necessary for the titration.

Picture No. 16 shows a rotating titration table which is used to hold and rotate the titration dishes in any drop scale titration. This device permits the operator to impart remote rotation of the titration dish and thus saves the operator from undue exposure to radioactive materials. The speed of the rotation can be readily controlled as well as varied. The stirrer consists of a small holder, punched in the center to hold a standard micro titration dish and with the outer edge cut and bent down to provide a series of vanes. The entire assembly sets on a suitable bearing. A metal tube directs compressed air against the blades. Air is supplied to the tube through a rubber tube connected to a suitable source of air pressure. To prepare the device for use, connect a piece of rubber tubing long enough to provide

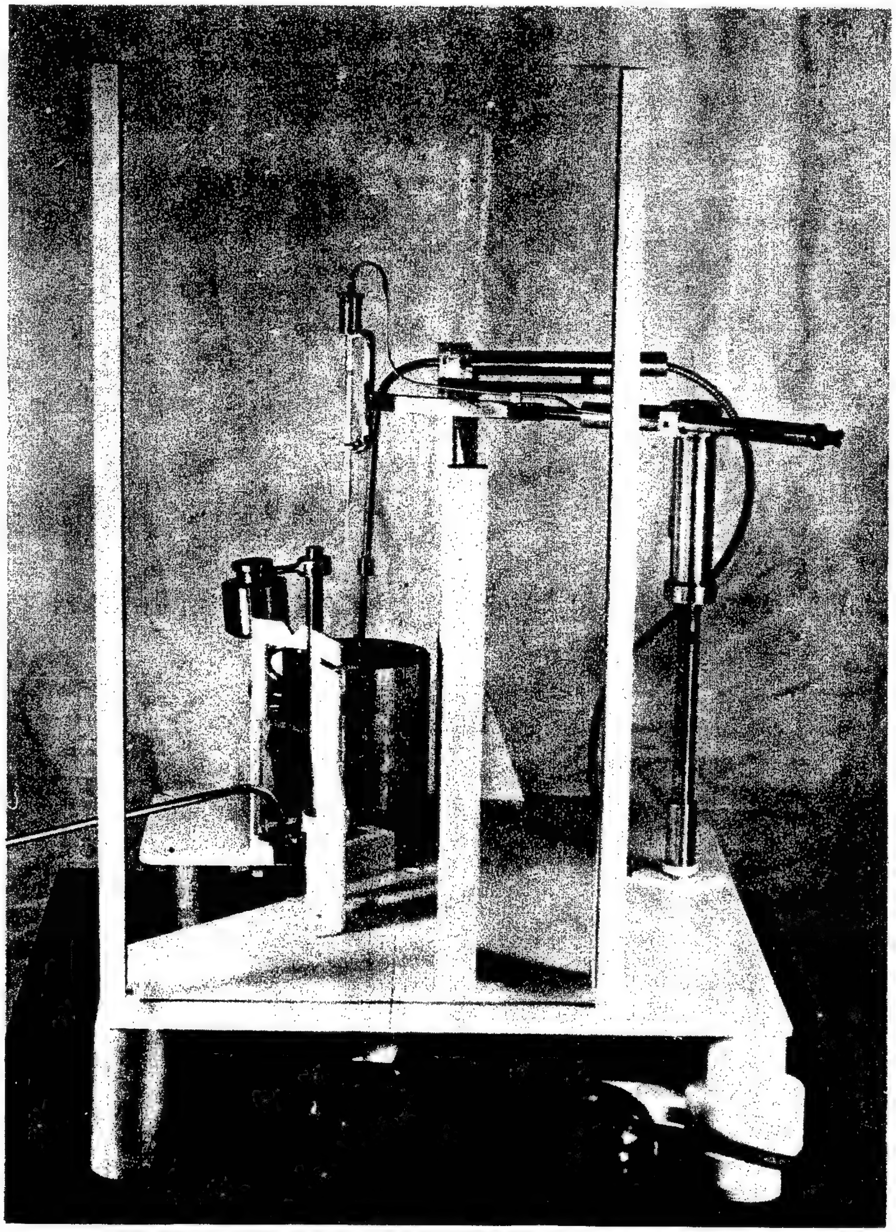
the desired remoteness to the metal nozzle. To this tube connect either a squeeze bulb or a "T" tube. In the latter instance, one arm of the "T" tube should be very short and the third arm connected to another piece of rubber tubing leading to a source of air pressure. The bulb type rigging provides ready control over the air blowing to the rotating table and it is generally used where short rotating intervals are desired. Where long continued rotation is desired, the latter procedure is recommended. In use, the rotating table is set on whatever base is to be used for the titration. The titration dish is set on it and the burette is inserted into the solution to be titrated. The rotating table should be rotated slowly since high speeds may throw the solution out of the titration dish.



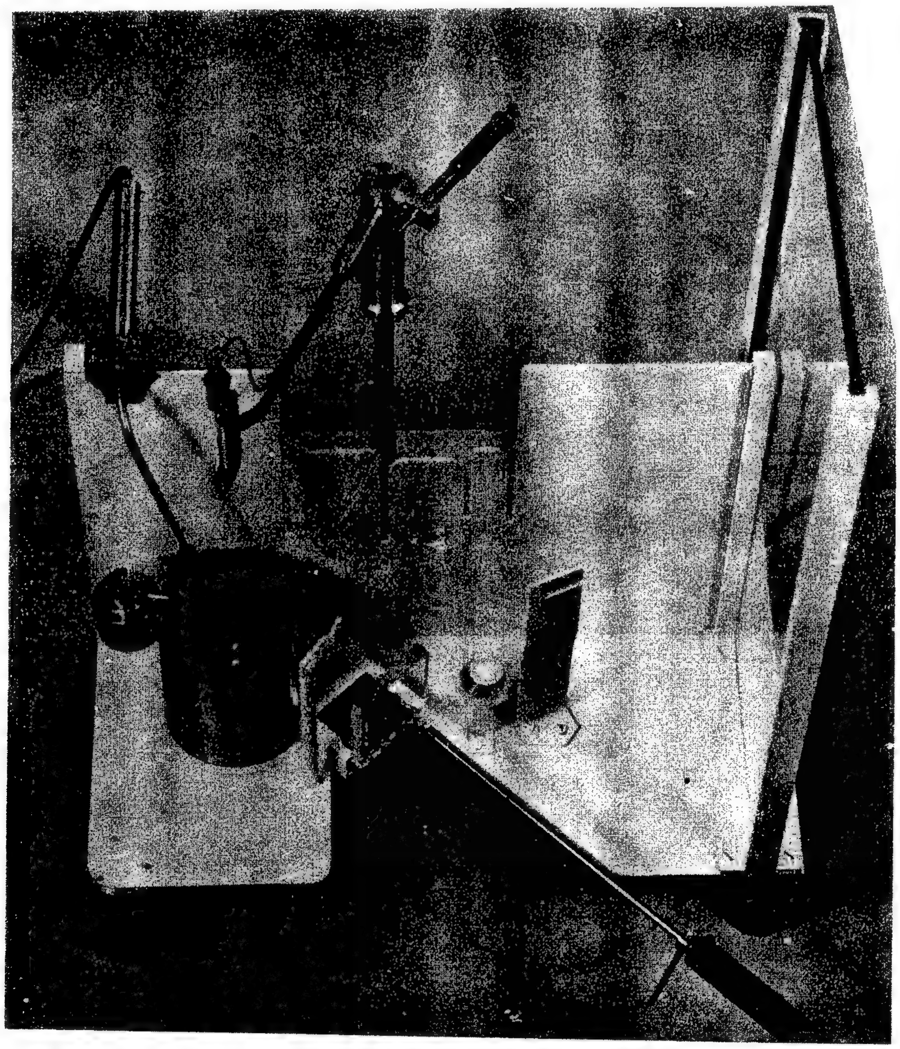
Picture No. 1 —Figure 1.



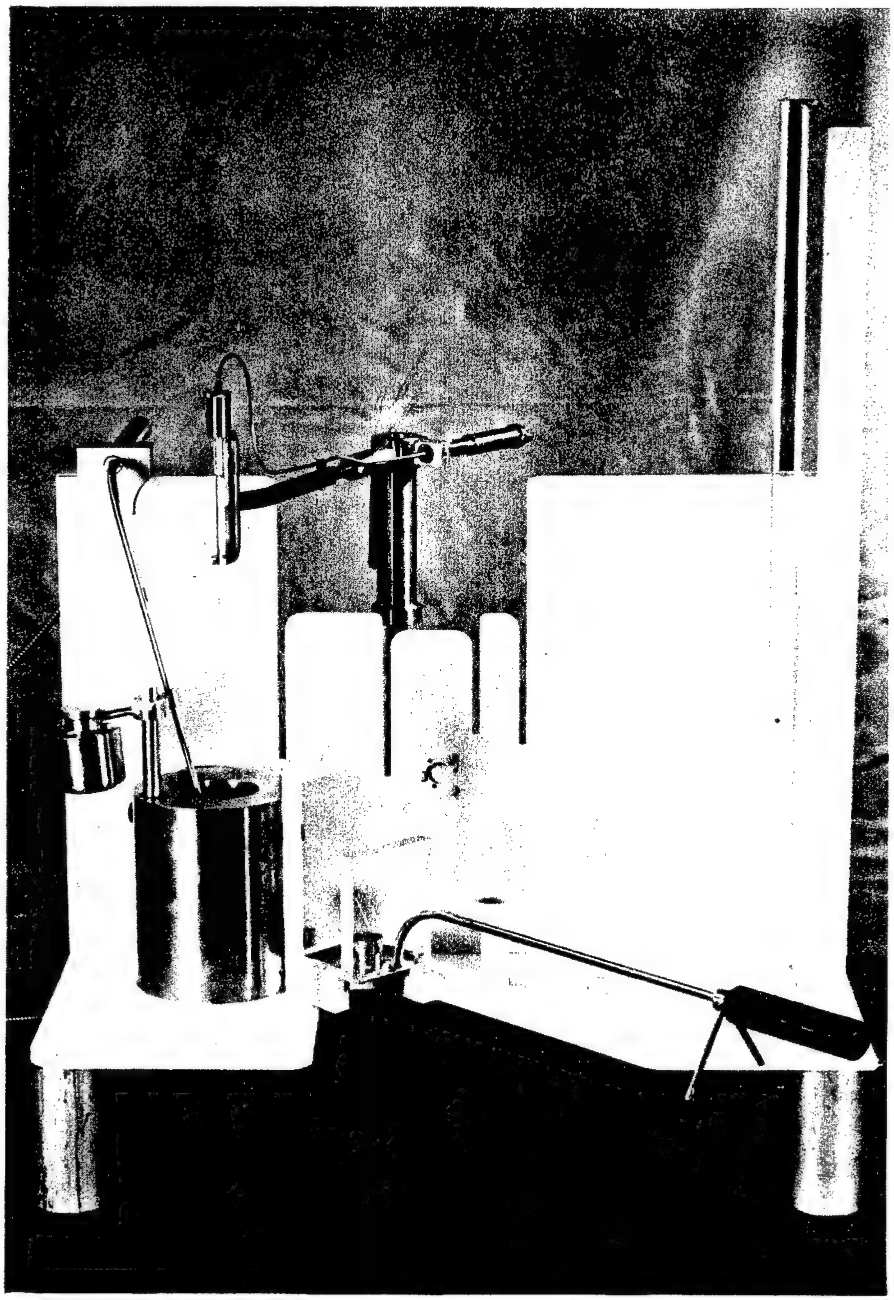
Picture No. 1 — Figure 2. Panel (rear view).



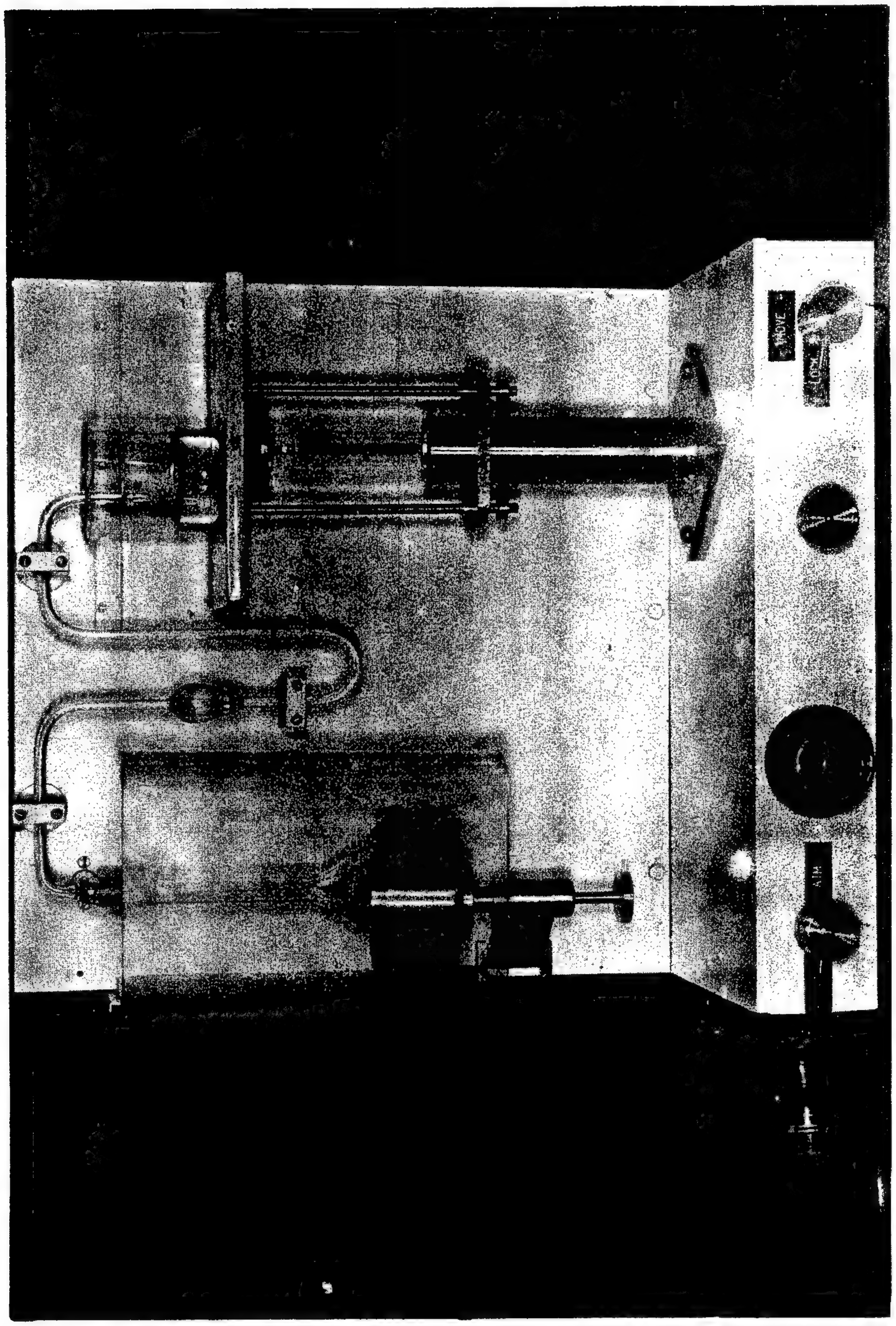
Picture No. 2 — Figure 1. Primary sampler.



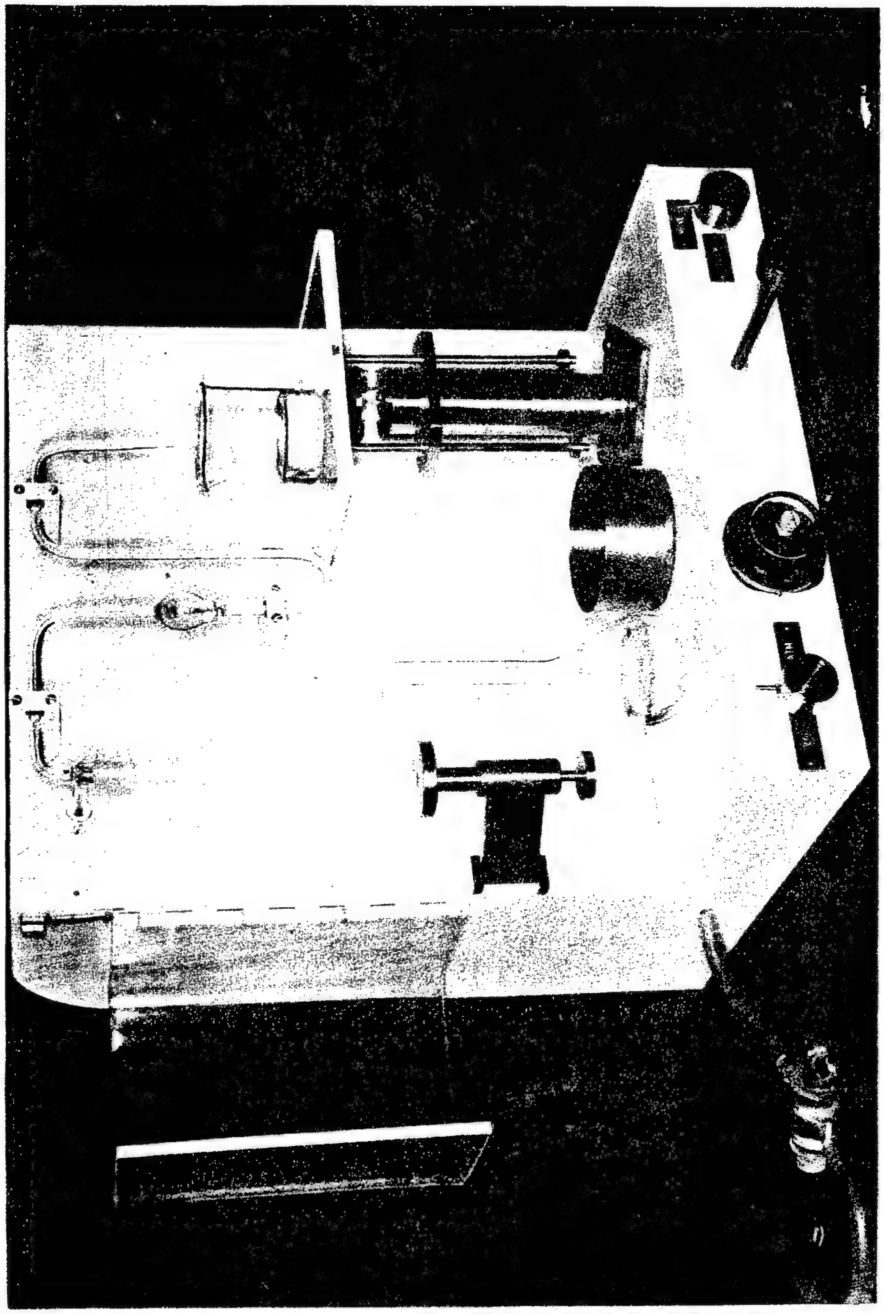
Picture No. 2—Figure 2. Primary sampler.



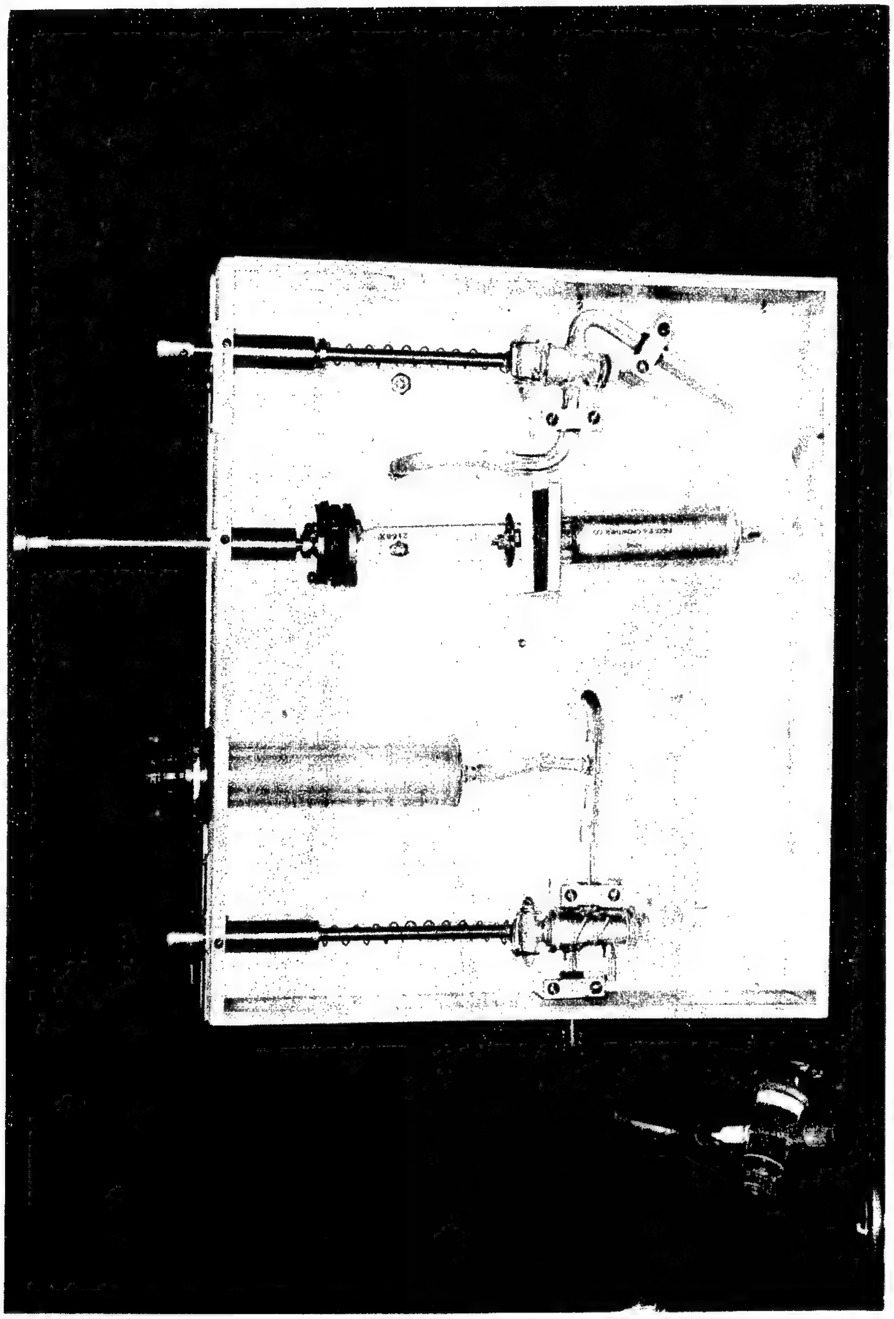
Picture No. 2—Figure 3. Primary sampler.



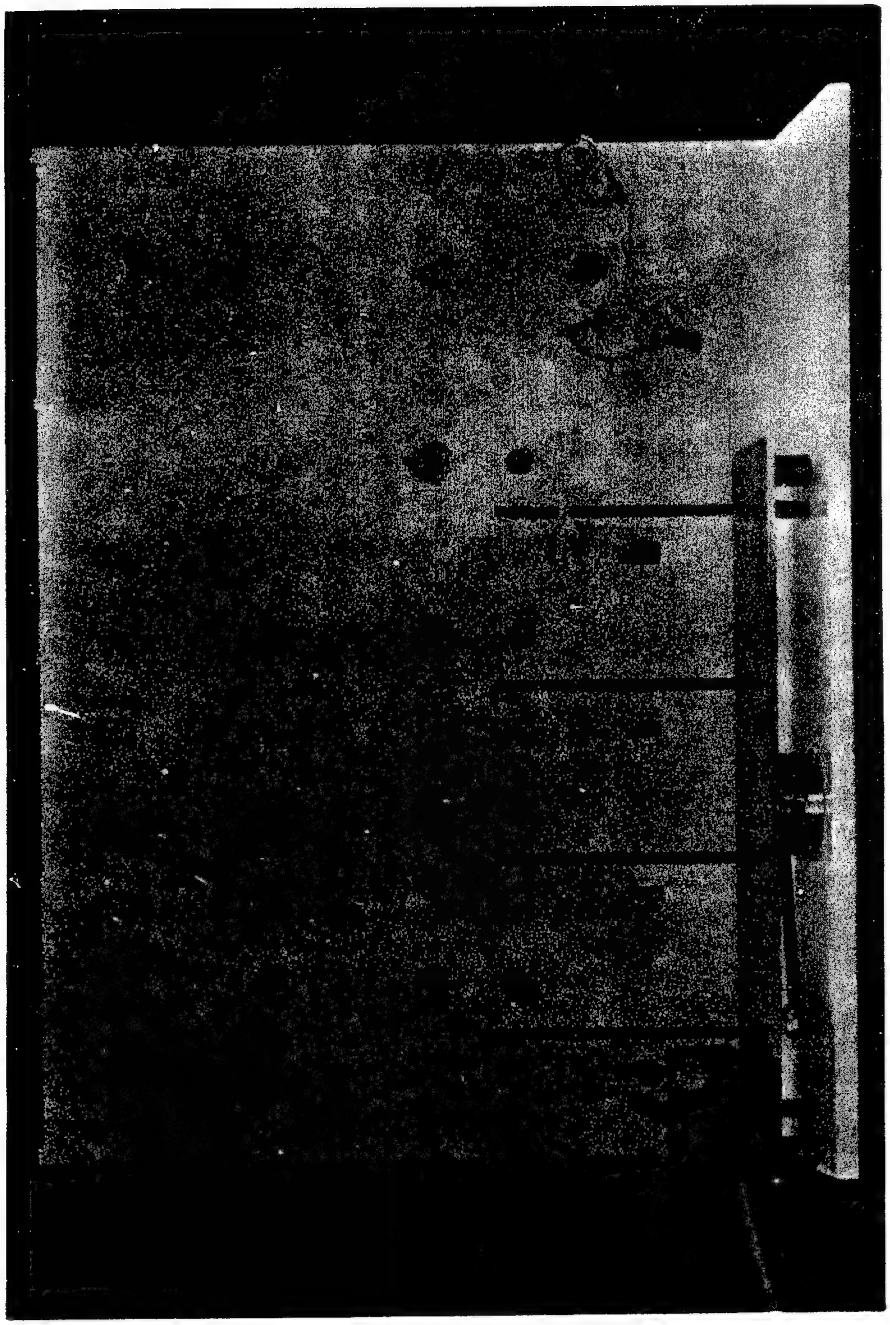
Picture No. 3 — Figure 1. Continuous liquid-liquid extractor LTW (front view).



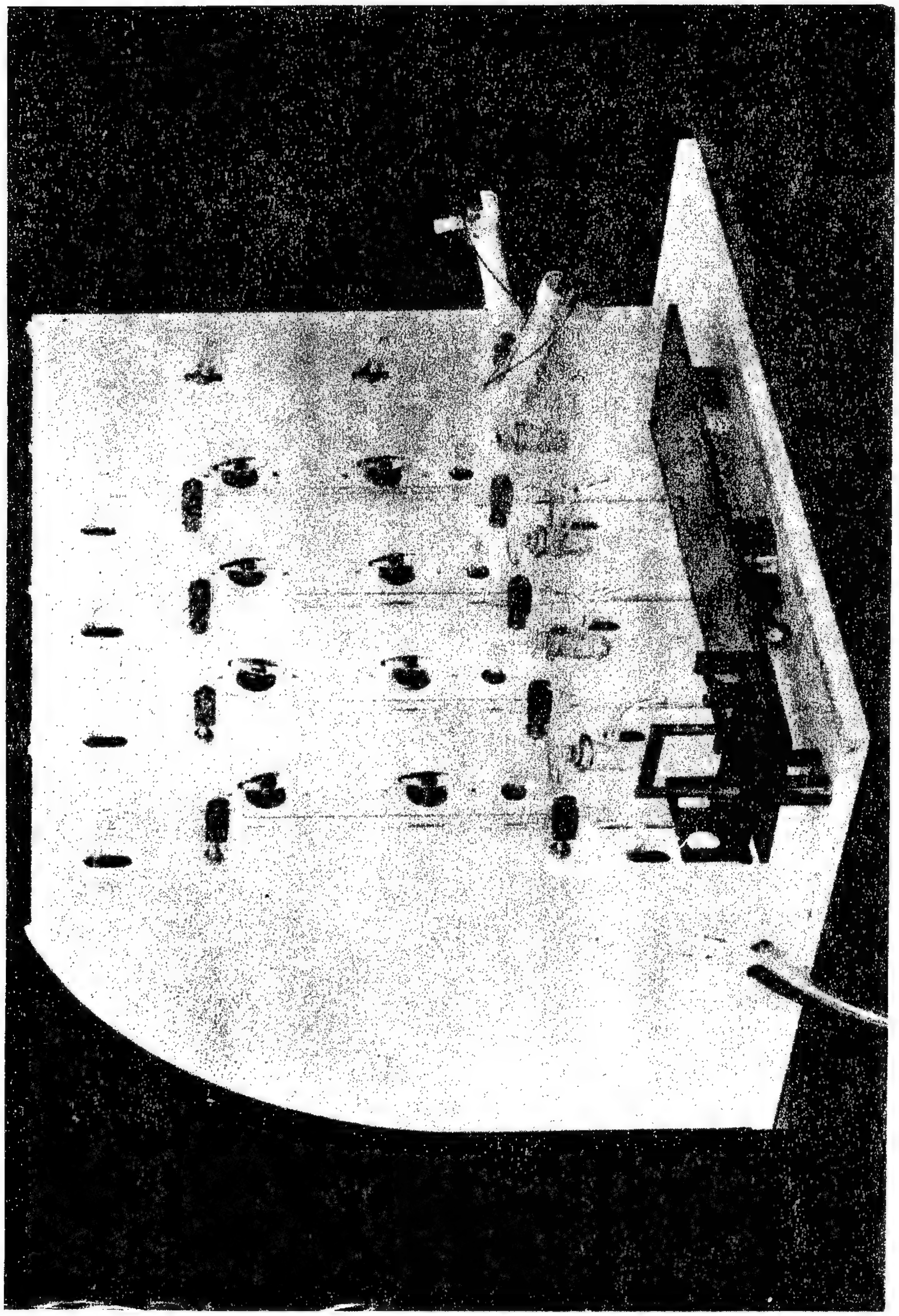
Picture No. 3 —Figure 2. Continuous liquid-liquid extractor LTW (side view).



Picture No. 3 —Figure 3. Continuous liquid-liquid extractor LTW purety panel (bottom view).

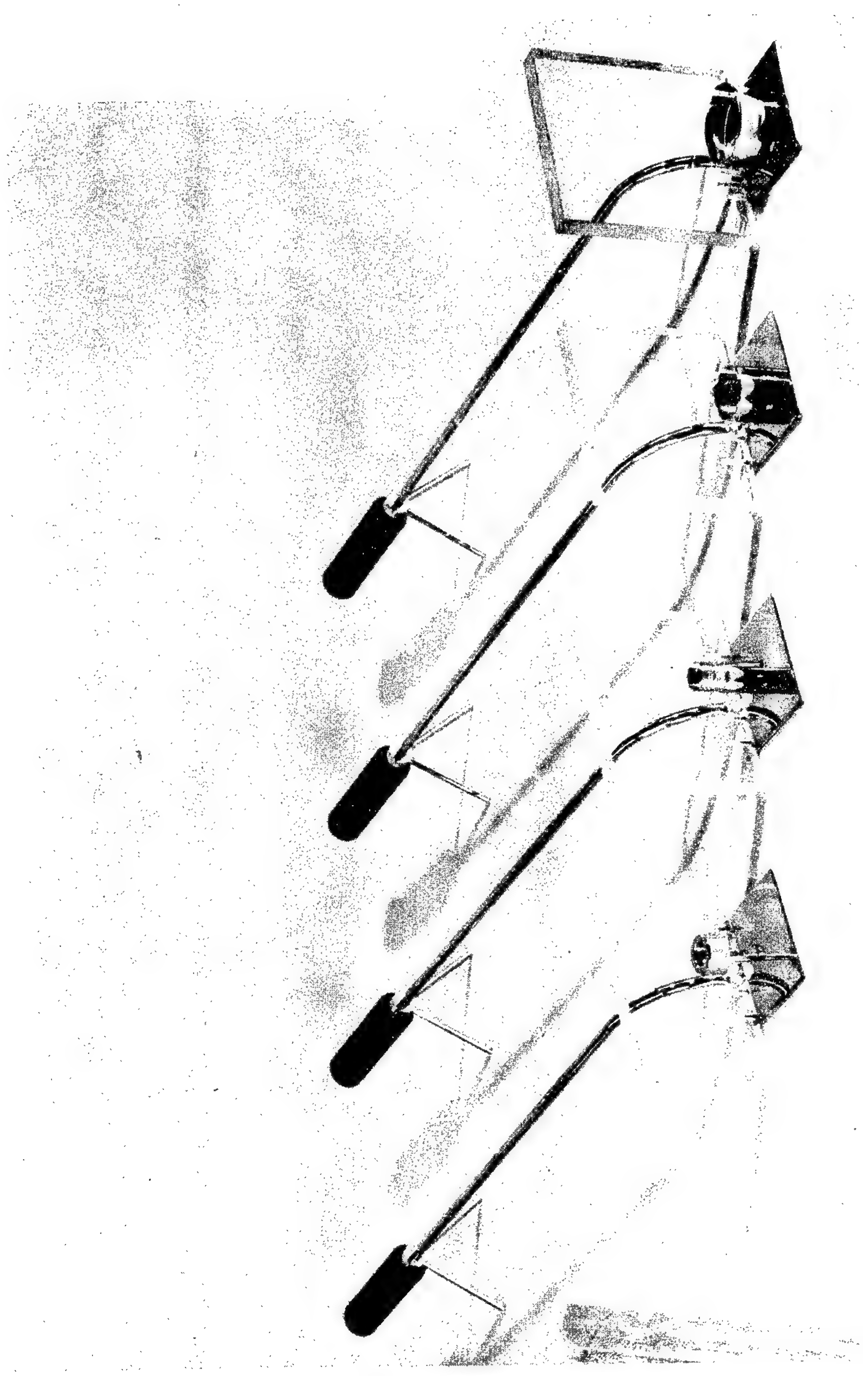


Picture No. 4 — Figure 1. Iron panel board (front view).

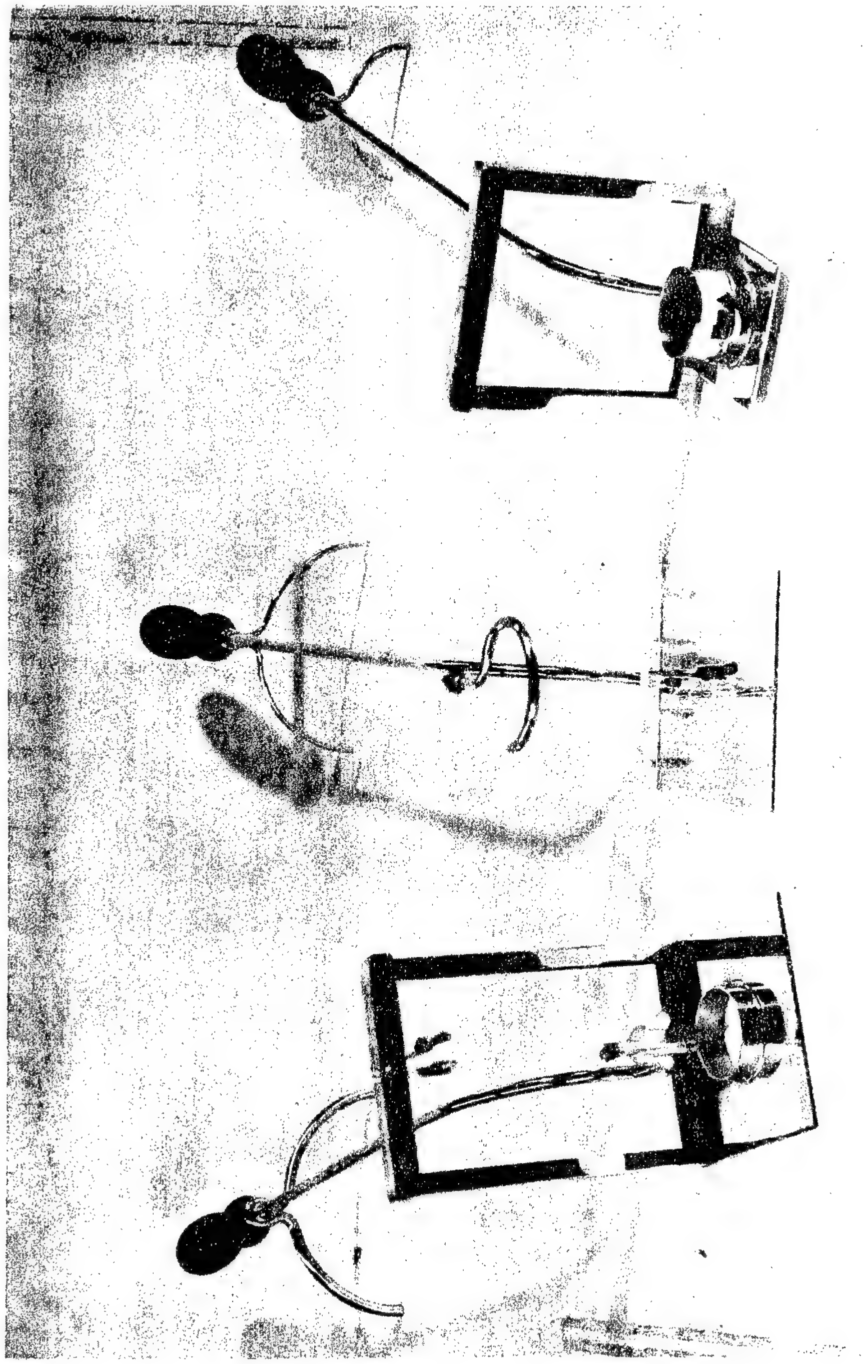


Picture No. 4 —Figure 2. Iron panel board (side view).

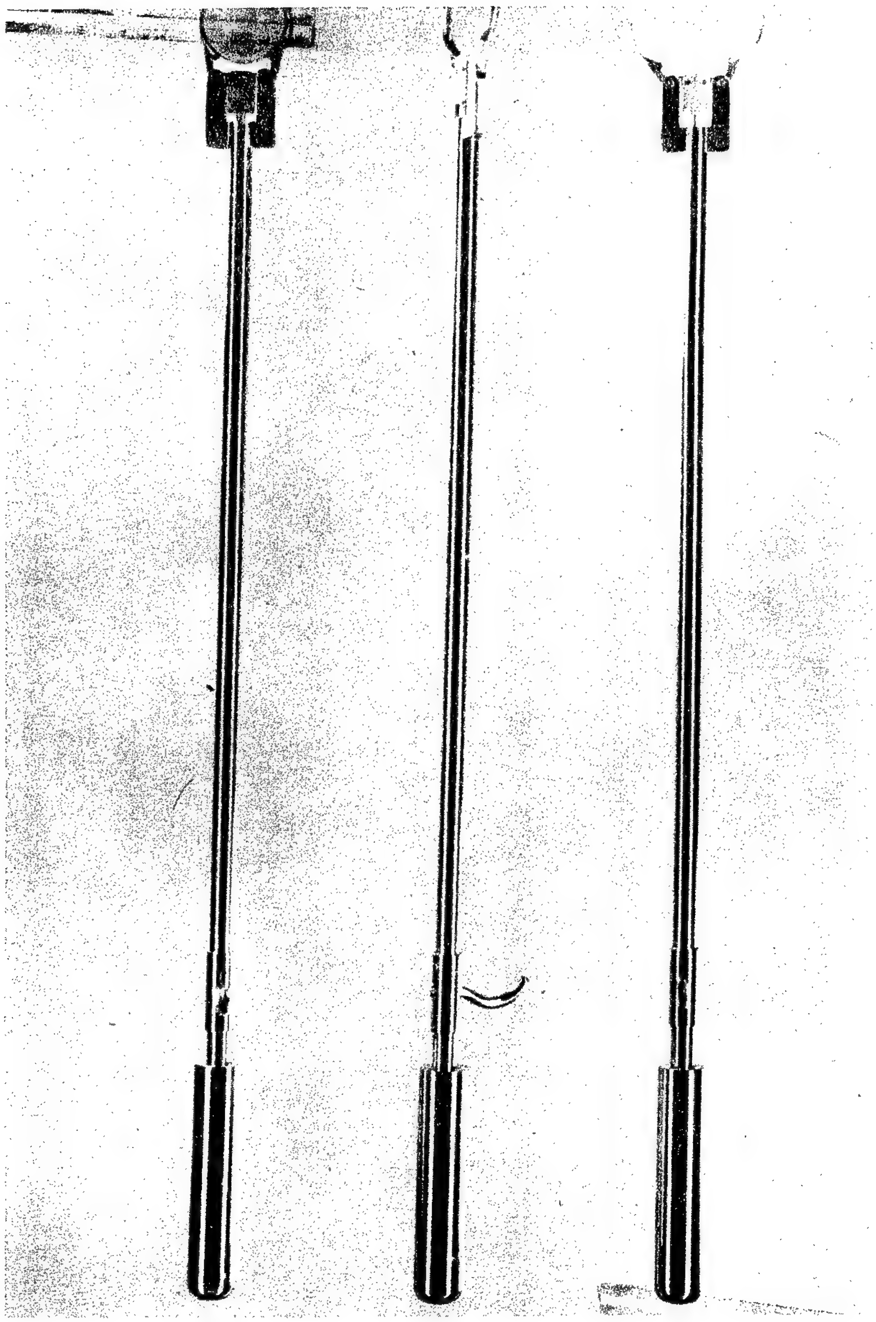
Picture No. 4 — Figure 3. Iron panel board (back view).



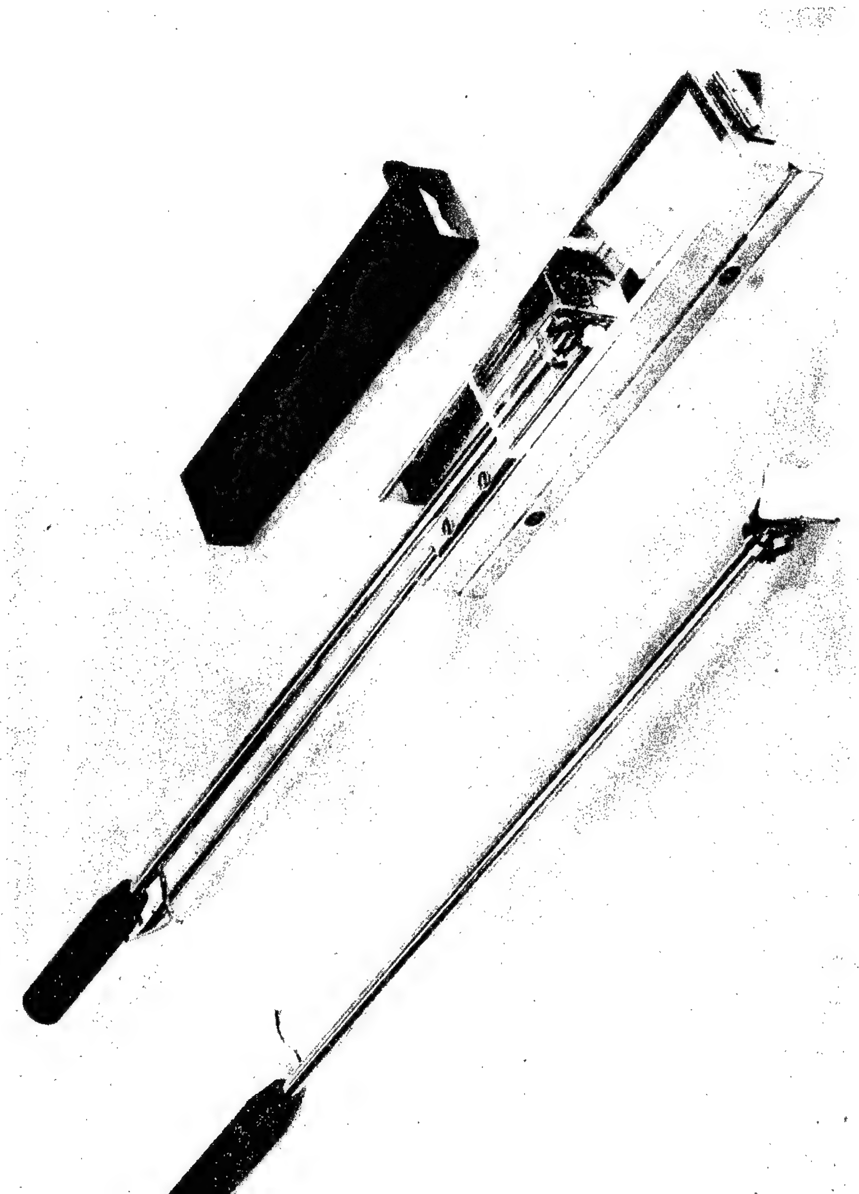
Picture No. 5 — Figure 1. Vessel holders.



Picture No. 5 — Figure 2. Vessel holder.

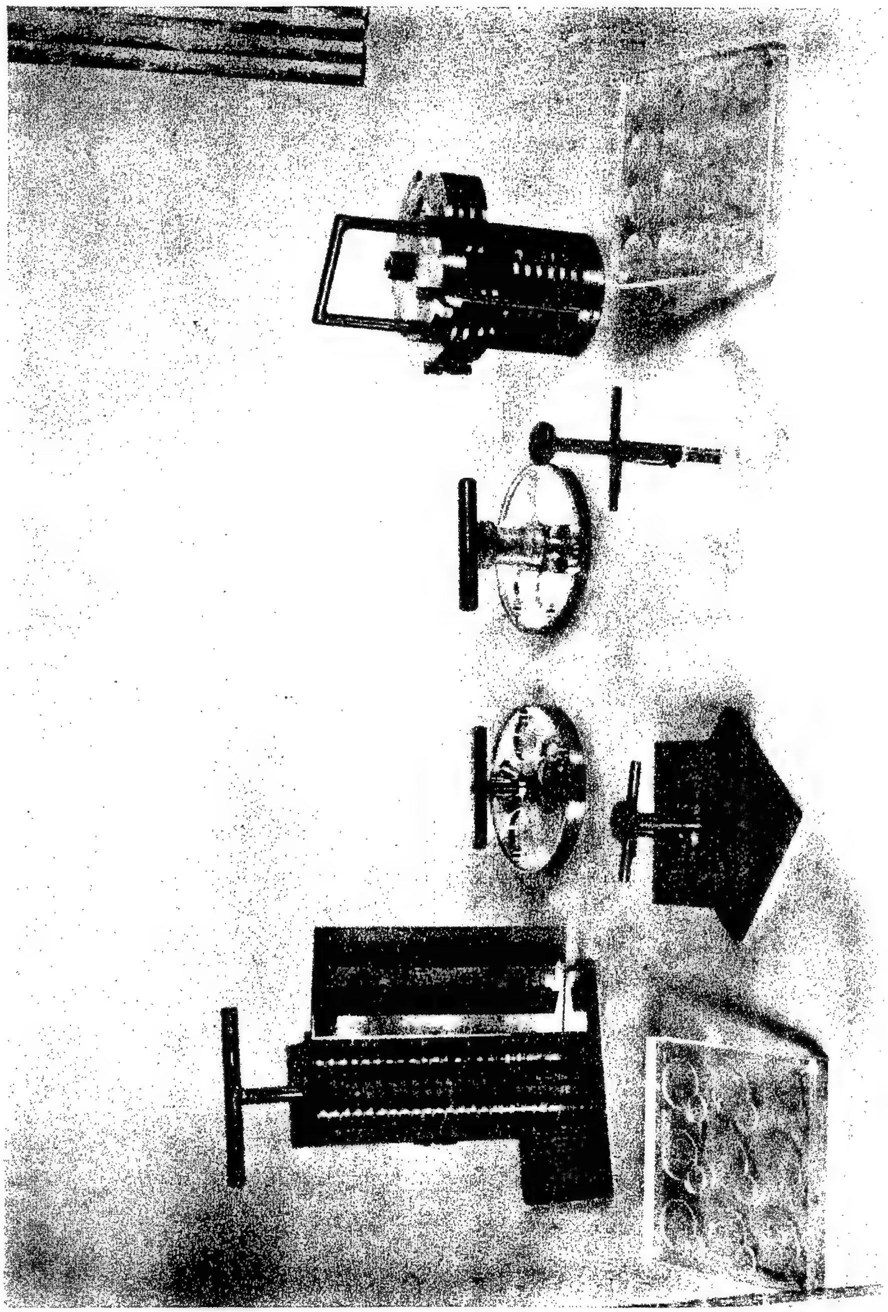


Picture No. 6 — Titration dish tongs.

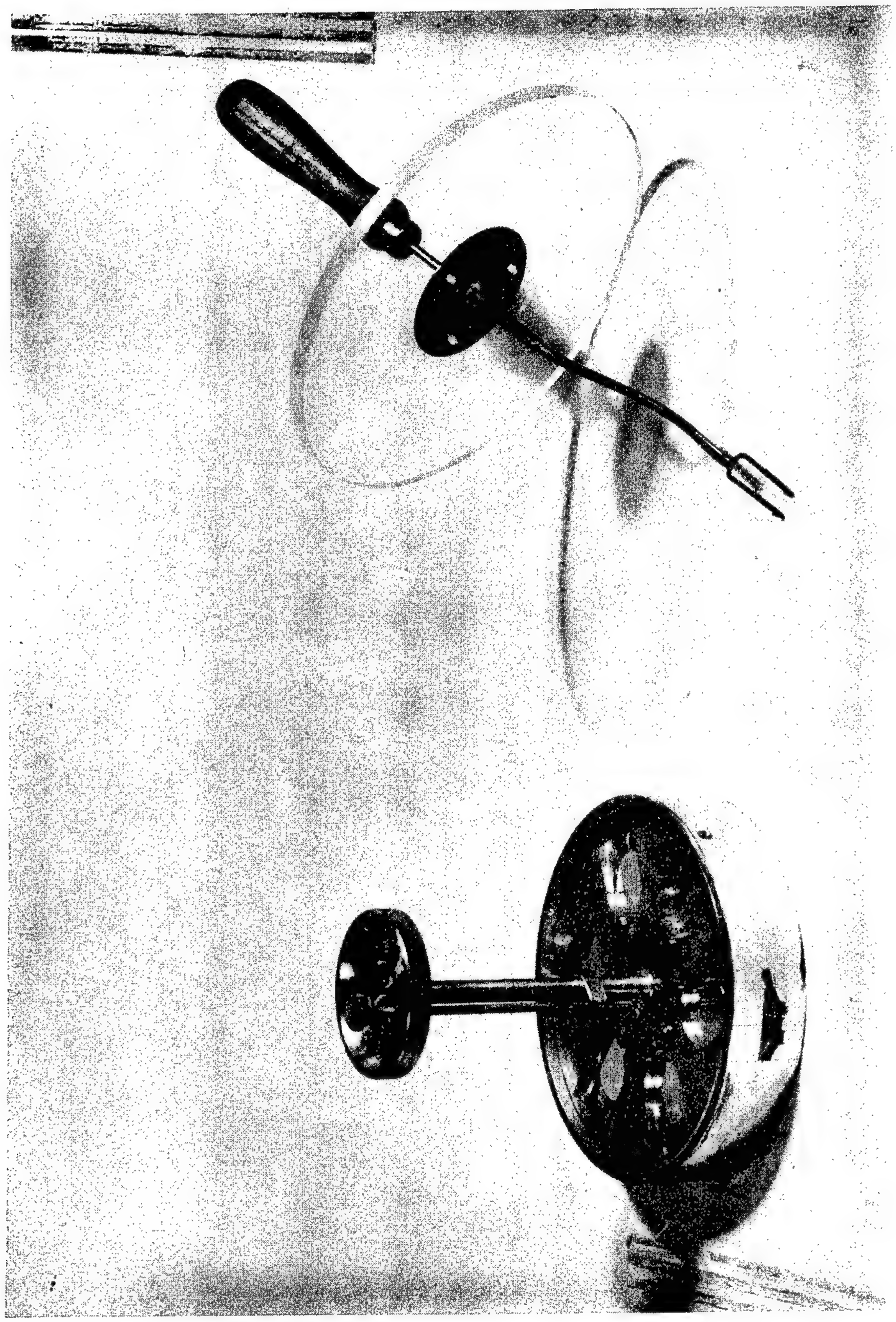


Picture No. 7 —Wiring tongs.

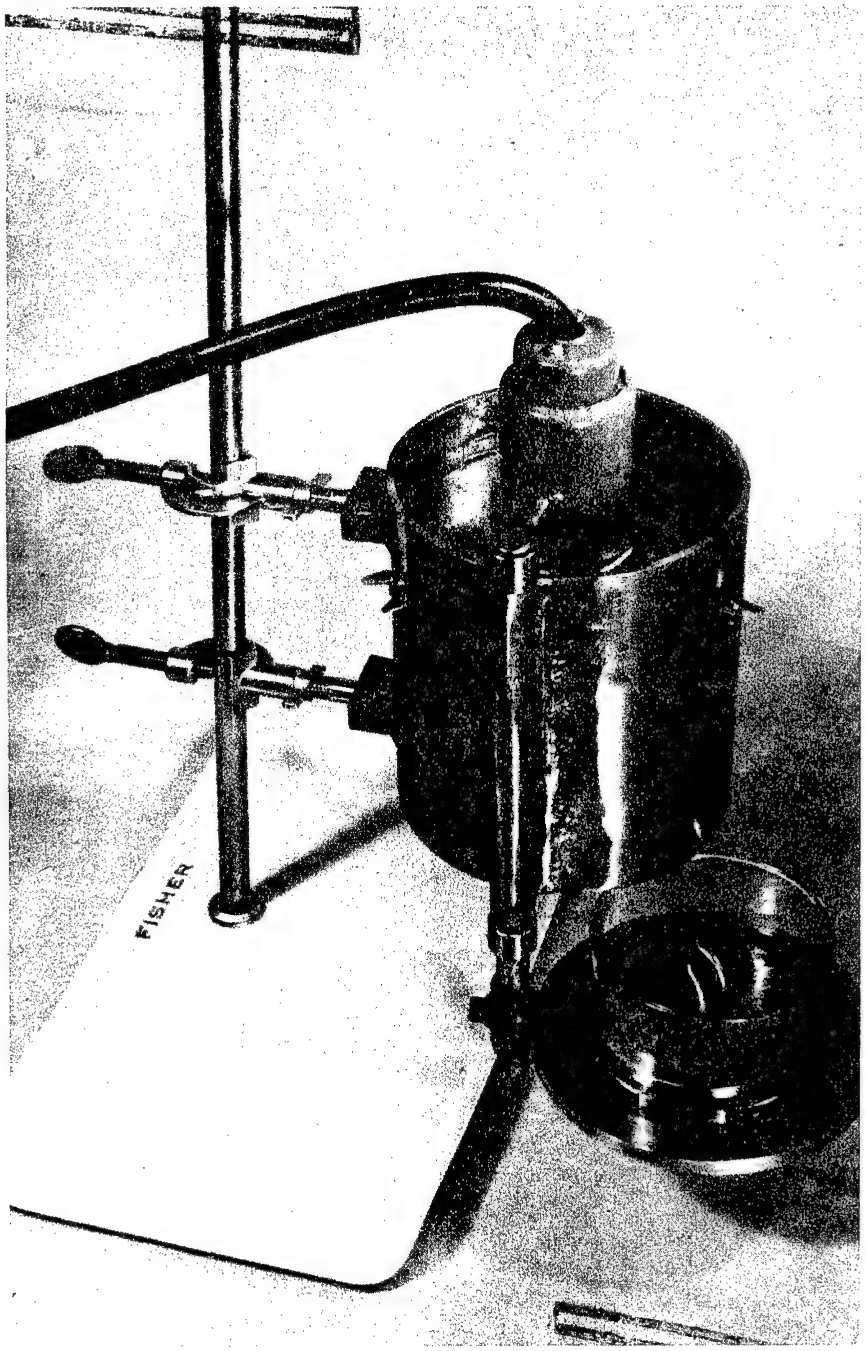
Picture No. 8 —Remote control handling tongs.



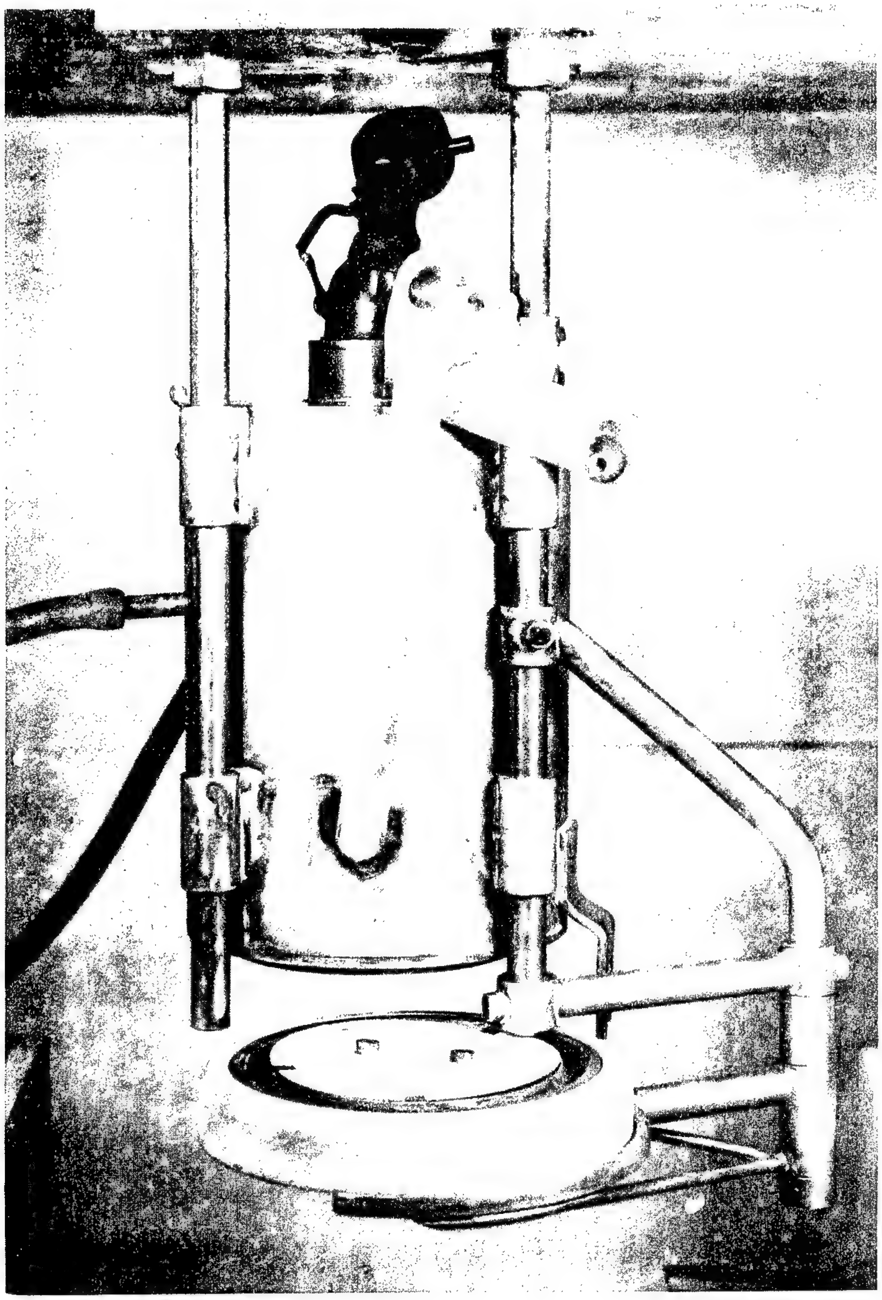
Picture No. 9 — Disc carriers.



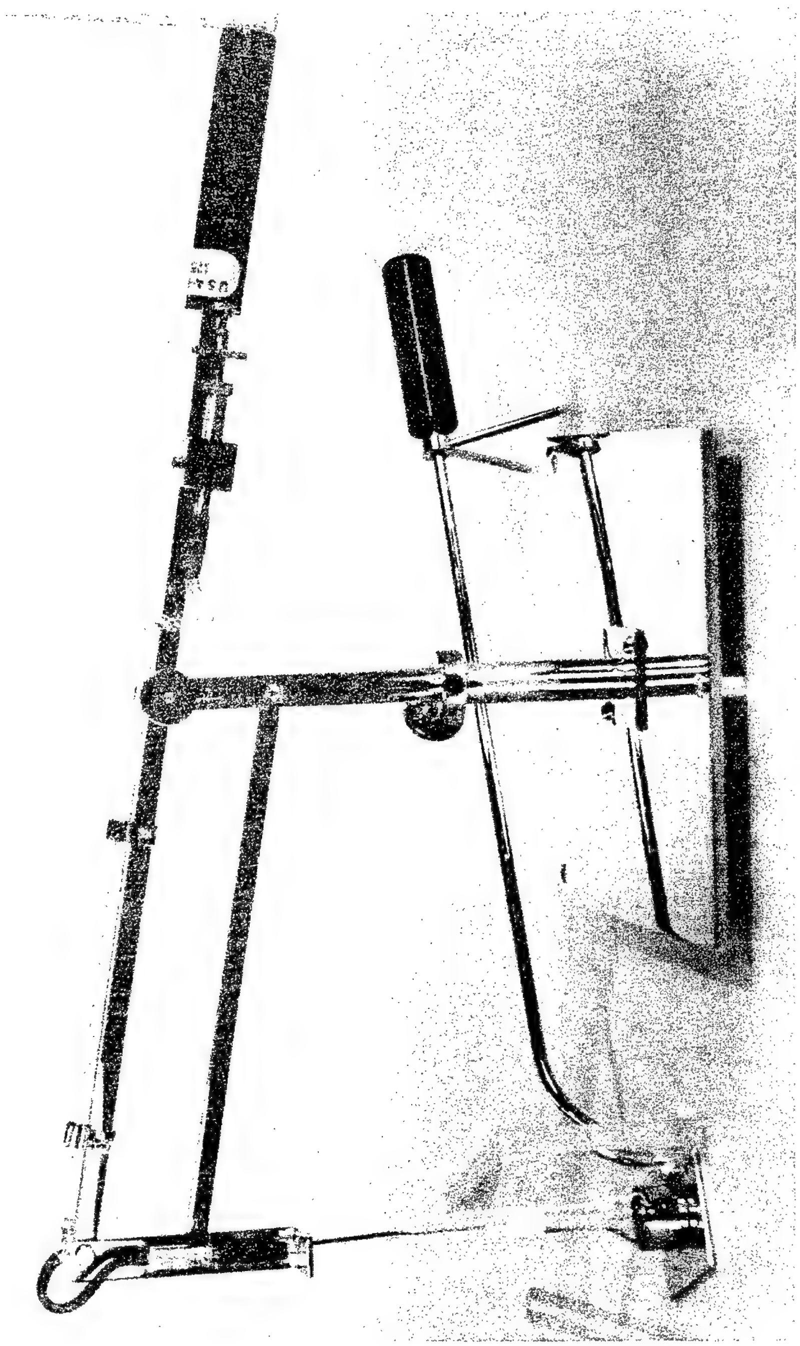
Picture No. 10 — Lucite covered rotary dish holder and tongs.



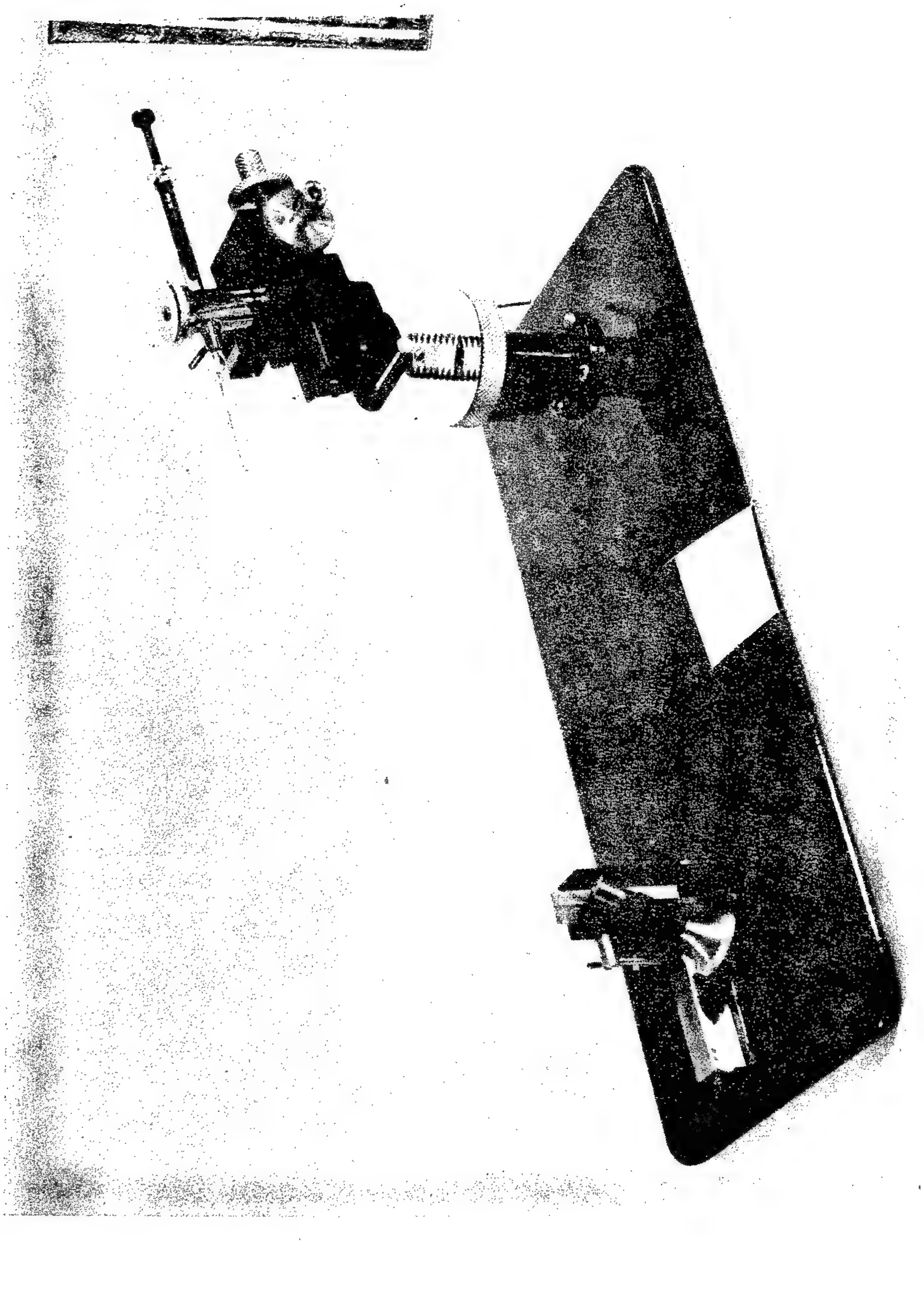
Picture No. 11 — Hooded evaporator.



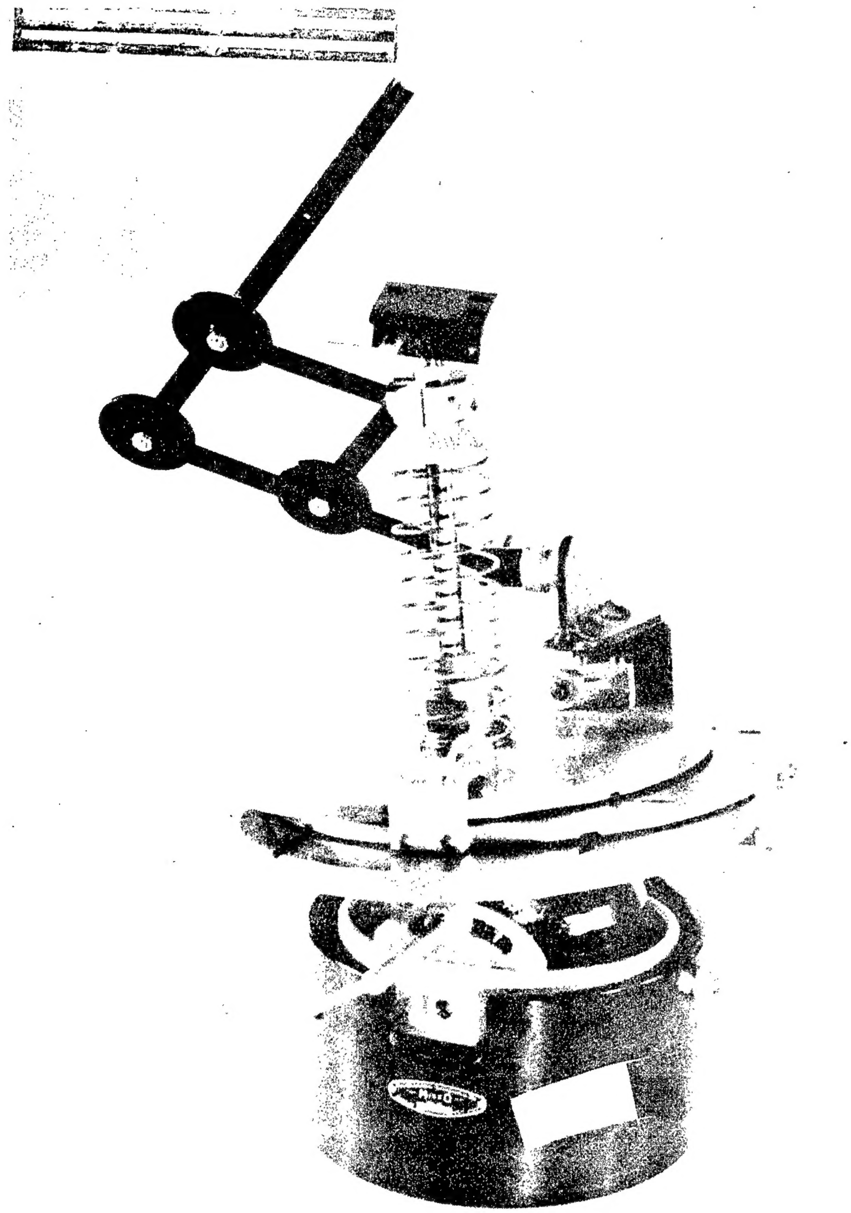
Picture No. 12 —Hooded evaporator improved.



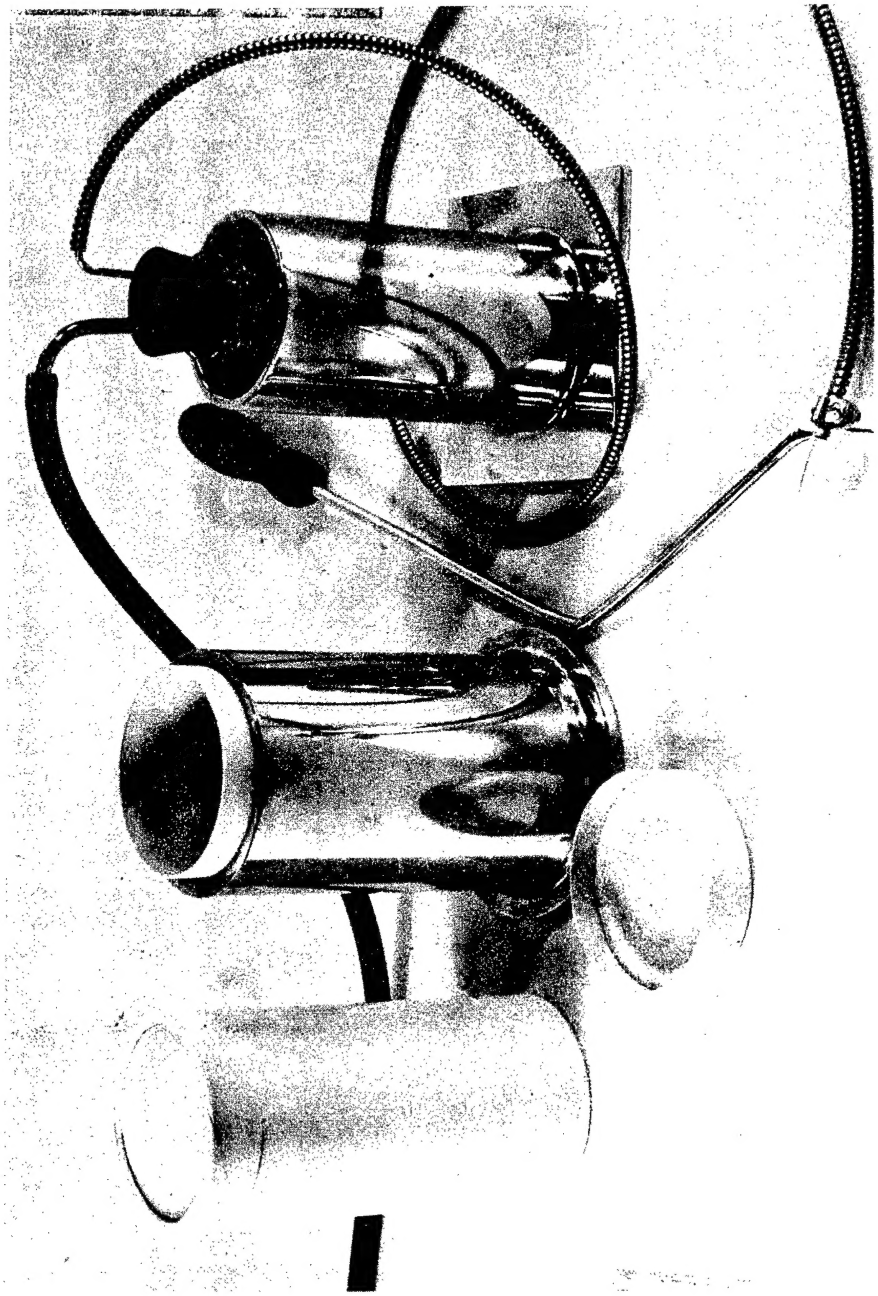
Picture No. 13 — Figure 1. Manipulator —pump handle.



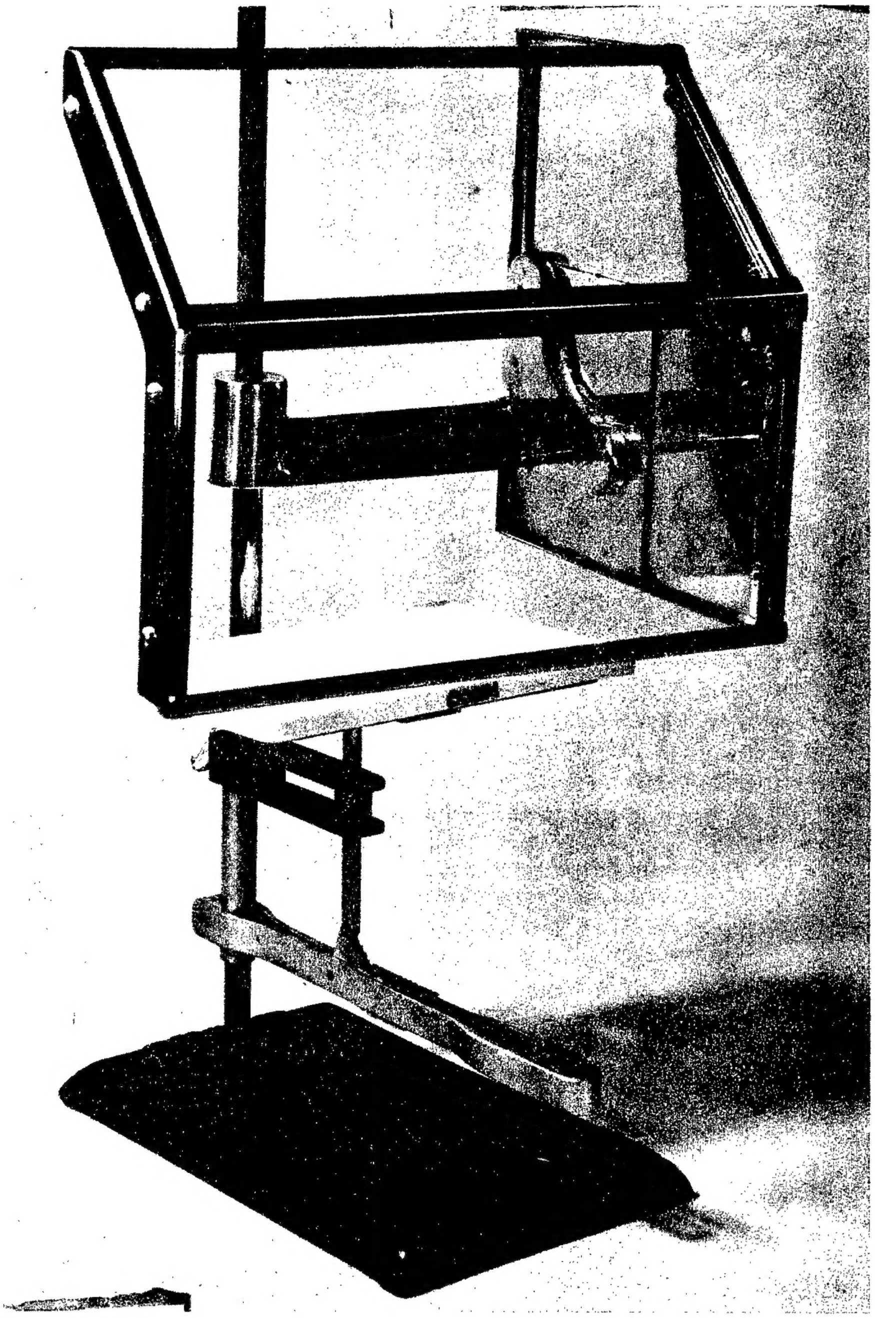
Picture No. 13 —Figure 2. Special misco manipulator.



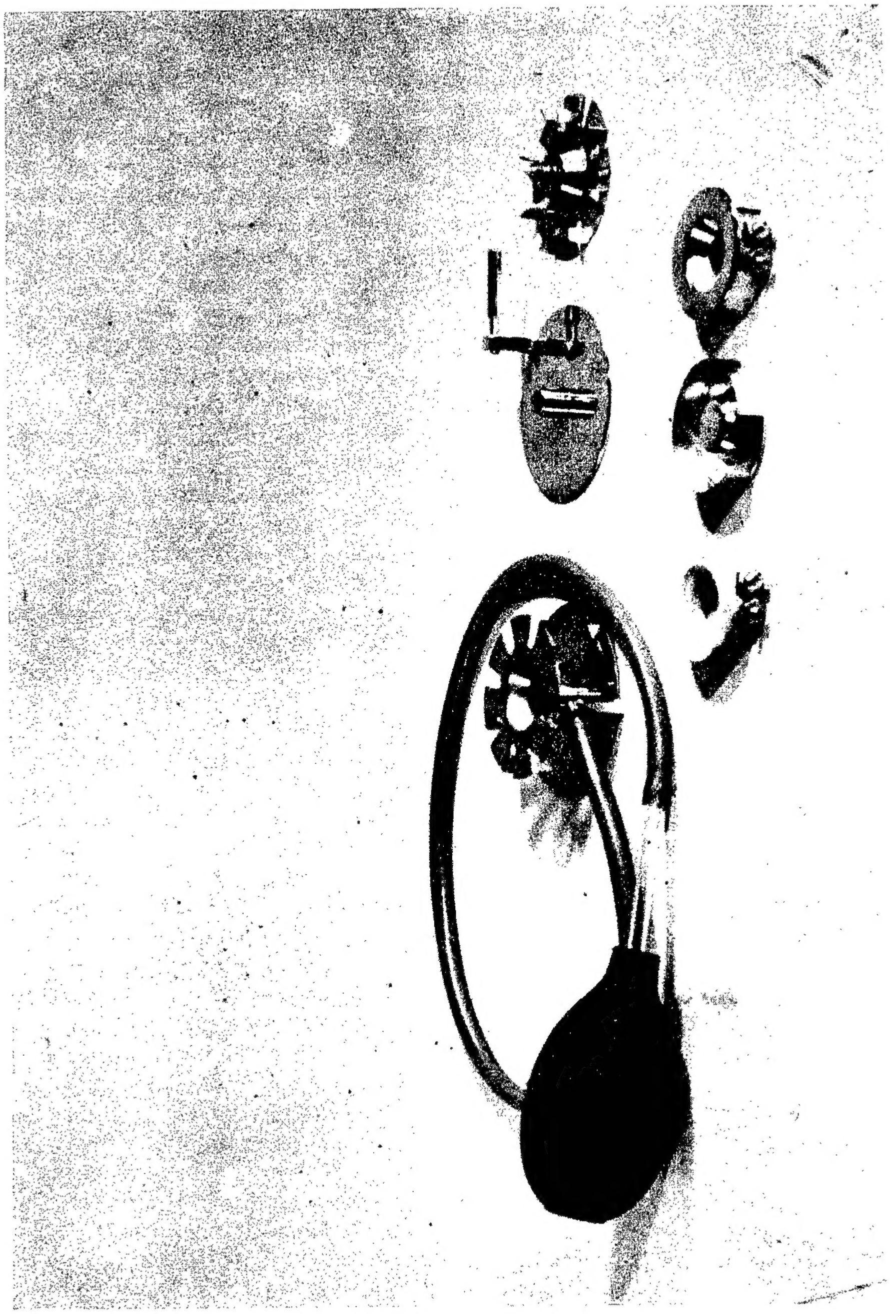
Picture No. 13 — Figure 3. Triple platen manipulator.



Picture No. 14 —Dry waste disposal shield.



Picture No. 15 —Modified titrating table.



Picture No. 16 — Rotating titrating table, assembled and unassembled.

END OF DOCUMENT